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USING THE TECHNOLOGY ACCEPTANCE MODEL TO PREDICT LECTURERS' ACCEPTANCE OF AUGMENTED REALITY NOTES

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Abstract

Teaching and learning have already been leaping forward by adding advanced technologies such as augmented reality. The main purpose of this study is to predict Malaysian Polytechnic lecturers who teach Wireless Communication subject, on their acceptance level of incorporating Augmented reality into learning material using the Technology Acceptance Model (TAM). The questionnaire was distributed to 40 polytechnic lecturers who teach this subject nationwide. Pearson Correlation analysis using Statistical Package for the Social Sciences (SPSS) *software was used to test all the hypotheses. The data analysis indicates that about 87.5 % of Malaysian polytechnic lecturers who teach wireless communication subject currently accept to incorporate AR in that subject. Using Technology Acceptance Model, the study reveals that lecturers perceived that Augmented Reality is easy to use (PEOU), and useful (PU) and therefore has a positive attitude (ATU) towards using it. This results in positive behavioral intention (BI) to use AR in their teaching and learning*

material for this subject. This study emphasizes on TAM model to understand and explain behavioral intention to use Augmented Reality among Malaysian polytechnic lecturers who teach wireless communication subject. However, the scope of this study can be widened by investigating the acceptance level for other subjects too.

Keywords

Augmented Reality, Technology Acceptance Model, Wireless Communication, Polytechnics

1. Introduction

DEP50063 Wireless Communication is one of the subjects taught in all polytechnics in Malaysia which offers an Electronic-Communication Diploma Program. The syllabus for this subject comprises cellular communication in which students need to visualize cellular structure and understand the concept behind cellular as well as network coverage coming from base station antenna. Students also need to understand the frequency allocation for each cell, the location of the base station as well as its structure. Furthermore, students need to learn the actual wiring connection of the base station which can be done by visiting the actual cell site, however, this is often missed due to endemic, budget, and time constraints. In addition to that, students need to imagine and visualize the concept of multiple access techniques that explains how frequencies are shared by multiple subscribers as well as how it is being processed and interpreted at the transmission and reception level.

As these learning outcomes involve electromagnetic waves that cannot be just seen with observation through the naked eye, which otherwise can be shown via lab experiments, these learning outcomes can only be achieved with graphical visualization and illustration. The more detailed the graphical illustration is, the better one can understand on the content of this subject. Thus, there is always a demand to create an advanced illustration method to be incorporated into teaching and learning for this subject.

Although, there are many resources available online such as animation videos, 2 Dimensional (2D) and 3 Dimensional (3D) images, these resources are way too many and too dense rather than specifically focusing on the content of the polytechnic syllabus. Sometimes, students get drifted away searching through a dense pool of resources and watching strings of videos online, and only find out that they have not yet found the intent of their actual search. That is why students preferred a more centralized and quick way of getting the content they need. Under

the polytechnic environment in Malaysia, studies proved that digital-learning platforms hold the highest demands as compared to other learning platforms and tools hence proving that students' preference for digital learning content to be shared into more localized and centralized platforms as it offers a quicker way to get grab the content on the go.

That is why incorporating advanced technology such as Augmented Reality (AR) can help to achieve this. Augmented Reality (AR) is one of the most important pillars among the other 9 pillars of Revolution 4.0. Thus by adding during the early days of their education, students can prepare themselves for IR 4.0 later in their career life as it is already been widely used in many industries. A recent study conducted in a community college has proved that using Augmented Reality in learning materials can positively affect on student motivation to learn (Salwa et al., 2021).

However, currently, there is a lack of Augmented Reality(AR) usage in learning materials for Wireless Communication subject. Hence, a module incorporating AR is created for selected topics (areas mentioned initially) and has been distributed to Malaysian Polytechnic lecturers who teach wireless communication subject. Nevertheless, for the learning tool to be effective, the technology has to be first used. In that context, Polytechnic lecturers will have to accept this technology and have the intention to use it continuously. According to Ayman Ahmed AlQudah (2014), the introduction of new systems shows failure because end users do not accept either due to complexity or because it doesn't seem useful.

Therefore, this study is conducted to predict among the Malaysian lecturers who teach Wireless Communication subject on their acceptable level of Augmented Reality notes. The acceptance level is investigated using Technology Acceptance Model (TAM), a well-known model. In other words, this study projects TAM into the academic setting of the polytechnic institution to determine the possible acceptance level of AR technology. This research is guided by the following question: Will Augmented reality be accepted by lecturers and continually use it? Based on Figure 1, the TAM model consists of components such as perceived ease of use (PEO) and perceived usefulness (PU). This can be used to investigate whether polytechnic lecturers' attitudinal beliefs such as perceived use of use (believing it is user-friendly for them) and perceived usefulness (believing it is useful) can predict AR adoption. By this, the study uses the TAM model to predict the possibility of acceptance of AR and provide a well-supported prediction of whether will be used in the teaching and learning environment at Malaysian polytechnics.

2. Literature Review

The literature review states and explains past research and articles related to the current topic. Much research has been found related to Augmented Reality.

Augmented Reality is an advanced software tool that is used to integrate 3 Dimensional objects into the real environment in real-time using any digital device such as a smartphone. Although the appearance of AR dated back to the 1950s through the innovation made by Orton Heilig a cinematographer, sources stated that Ivan Sutherland was the first one to create AR using a see-through optical device with a head-mounted display back in 1968 (Carmigniani & Furht, 2011). Carmigniani (2011) also mentioned in his book that later in 1975, Myron Krueger develops *Videoplace* a room that enables users to interact with virtual objects.

Currently, Augmented Reality is used in a wide variety of industries. For instance, a well-known furniture company uses AR to give real experience for customers on how a certain piece of furniture that they intend to buy will look if it is placed in their living room. By using mobile devices and installing applications as well as following simple steps, they can view the furniture as if it has been put into a corner of their house via their smartphone camera. The real-time experience encourages more customers and increases the companies' sales. AR is also widely used in other sectors as well. In this section, how far AR technology gives a positive impact on Education and Engineering Education, as well as Technology Acceptance Model is looked upon based on previous studies.

2.1. Benefits of Augmented Reality Towards Education: Studies related to the positive impacts that AR has on education are looked upon. This subtopic gives in-depth information on the benefits of AR in the education aspect.

Augmented reality is a 3D technology that supports individuals to understand and perceive the real world surrounded by objects created in a virtual environment (Leung & Blauw, 2020). The study mentioned that when conveying sophisticated topics that are complicated to explain using normal video or text formats, AR offers an enhanced method of conveying (Tolba et al., 2021). Augmented reality technology has not only the capability to improve the quality of education by promoting self-study among students but also able to stimulate students' interest in the learning material (Gurevych, et al., 2021). Furthermore, that study clarifies that AR technology helps develop the educational process and motivates learners to further study the material. In

addition to that, that study also concludes that modern students prefer visual education the best. Augmented Reality has already been practiced a few years back in many countries.

A systematic review from 2011 till 2021 on the use of Augmented Reality technology was conducted in one of the studies and a total of 103 studies through four iinter-disciplinarydatabases such as Springer, IEEE Explore, ResearchGate, and Google Scholar was done and concluded that in all level (preschool, primary, higher education, universities) that utilize AR has found to increase the academic level and motivations of students (Tolba et al., 2021)**.** The study also confirms that science is the most explored field in augmented reality (Tolba et al., 2021)**.** The same study also reveals that the best way in the learning process is when doing is involved rather than reading or listening as it includes more senses like light, sound, and touch (Tolba et al., 2021). Besides, in education institutions, Aris is also used widely in traininprogramses in industries, assembly lines, maintenance and repair, product design, and development (Tolba et al., 2021). In terms of student's perspective, a study was conducted to investigatestudents'opinionson and the effects of using AR in learning science and the result of this study indicated that AR had a favorable effect on the group's achievement interests and science process skills (Abdullah et al., 2022). Using technology can help to aid in the learning process as research proves that there is a positive impact of using mini-games to improve cognitive abilities for people with slow learning (Boudebza, 2017). Similarly, findings from the research reveal that creativity and critical reflection can be encouraged by digital comic creation.

2.2. The Impact of Augmented Reality on Engineering Education: This subtopic gives an overview with proof of studies on the impact AR has on education specifically in the engineering field. The Engineering field consists of much dense information that one may not rely fully on books only. Below are the details and studies that explain the impact on engineering education using AR.

Studies were conducted to investigate what the most researched topic when in it comes to AR and found out that, the most researched topic was development and testing (Vásquez-Carbonell, 2022). This reveals that many researchers focused on the development of new applications based on AR and testing these with the hope of improving the learning process among engineering students (Vásquez-Carbonell, 2022). The researcher also mentioned that the two most countries that have scientific documentation on AR are Germany and the software for creating AR Unity. In another study, the researcher investigates the impact of AR application on students

learning motivation in chemical engineering and results revealed that 82% of respondents found the AR delivery method helpful compared to the conventiontional lessons and that 92% were supportive of making AR lessons to be additional resources to existing learning materials (Darren et al., 2022). When it comes to mechanical engineering students, research was conducted to see the acceptance level of AR welding simulators in engineering training among 200 trainees and found that the intention to use AR simulator is positively influenced by attributes such as system quality and perceived to use (Papakostas et al., 2022). Taking this criterion in mind, the AR tool should comply with these criteria.

2.3. Usage of AR in Malaysian Polytechnics and Community College: This subtopic is on the level of AR usage in Polytechnics and Community College. These studies will help predict the outcome of using AR with colleagues.

Looking at the polytechnic perspective, the usage of AR is further studied in this section of the literature review. *Politeknik Sultan Abdul Halim Mu'adzam Shah* (POLIMAS), uses AR to aid fresh new intake of students on campus tours followed by a user acceptance study upon using it (Abu Bakar et al., 2022). In Politeknik Tuanku Syed Sirajuddin, Arau, Malaysia, the AR approach was used in Mechanical Workshop Practice specializing in welding and fitting workshops for mechanical engineering students (Zulfabli et al.,2019). Meanwhile, at Bagan Datuk Community College, a study was conducted to determine the level and difference in pre and post of using Augmented Reality as a teaching material in terms of students' motivation. The results reveal that before introducing AR the student's motivation is at a moderate level and has changed to a high level after using AR learning materials (Anuar et al., 2021). Besides, E-modules were also created for semiconductor subject which is to be utilized by TVET teachers (Johar & Abdullah, 2019). On the other hand, in another study, results reveal that there is a high demand for digital learning platforms and tools compared to conventional ones and the researcher also states that the results would be useful and be able to provide guidelines to Malaysian polytechnic lecturers to establish digital proficiency for enabling education 4.0 in future (Siti Dianah et al., 2020).

2.4. Technology Acceptance Model: This study adopts the Technology Acceptance Model (TAM) as the theoretical framework which is a well-known model to predict the acceptance level of technology and is created by Fred Davis (Davis, 1989). TAM model indicates that for a technology to be accepted, two factors influence upon, it one is how easy people believed it is to be used or in other words user-friendly features, and also how useful one finds the technology to be (Davis,

1989). These two attributes will predict the users' attitude towards using the technology (either positive or negative) which will influence their behavioral intention to use and the actual usage itself (Davis, 1989). Below states the concepts of TAM as illustrated in Figure 1.

- Perceived Usefulness (PU) – The degree to which the potential end user will find the technology can improve their work performance.
- Perceived Ease of Use (PEOU) – The degree to which the potential end user can use it easily and smoothly
- Attitude Towards Using (ATU) – Feeling associated with applying a specific behavior, can be negative or positive for the potential user
- Behavioral Intention to Use (BI) – The degree to which the potential user has plans to unfold the specified behavior in future

Both PU and PEOU are direct influencers of ATU. Based on the TAM model as shown in Figure 1, PEOU directly influences PU where else, whereas PU directly influences BI. Meanwhile, potential user's attitude toward using directly influences BI as well.

TAM models have also been used to explain how perceived augmented reality affects consumer's perception and findings suggest that perceived augmented reality by consumers positively affects perceived enjoyment, perceived usefulness, perceived informativeness, and, perceived ease of use and thus resulting in consumers' behavior intention to use AR supported mobile applications (Oyman et al., 2022). In another study, TAM was also used to determine the factors that influence students' intention to use Virtual Reality (VR) in a dynamic learning environment (Fussel & Truong, 2021). Apart from that, the TAM model was used among college learners' mobile-assisted language learning by incorporating psychological construct and concluded that TAM may contribute to the long-term development of mobile-assisted language learning (Hui-Tzu & Chih-Cheng, 2021).

In one similar study, an interactive AR app was designed on resistive circuits for Engineering Students, and the TAM model was used to explain the acceptance level among engineering students. The results indicate that the academic environment can influence students' perspectives concerning the use of technology and reflect how students could be affected by important role models. This means that if the surrounding environment of students such as the lecturers and faculty value the benefits of technology, then they will have a positive opinion of their usage of technology (Alejandro et al., 2021). This is one of the reasons why the lecturers are

the first intention of this study because lecturers' acceptance of AR will influence the students to use it in the long run.

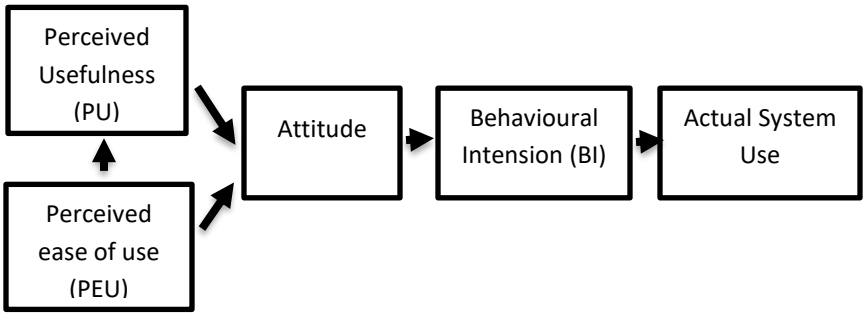


Figure 1: *Original Technology Acceptance Model*

(Source: Davis, 1989)

2.5. Study Hypothesis: The following is the hypothesis proposed:

H1: PEOU will have a positive effect on PU

H2: PU will have a positive effect on the attitude of Malaysian polytechnic lecturers' (who teach wireless communication subjects) toward using AR.

H3: PEOU will positively affect the attitude of Malaysian polytechnic lecturers (who teach wireless communication subjects) toward using AR.

H4: PU will have a positive effect on Malaysian polytechnic lecturers' (who teach wireless communication subjects) intention to use AR

H5: PEOU will have a positive effect on Malaysian polytechnic lecturers' (who teach wireless communication subjects) intention to use AR

H6: ATU will positively affect Malaysian polytechnic lecturers' (who teach wireless communication subjects) intention to use AR.

Based on the hypothesis, below is the proposed research model.

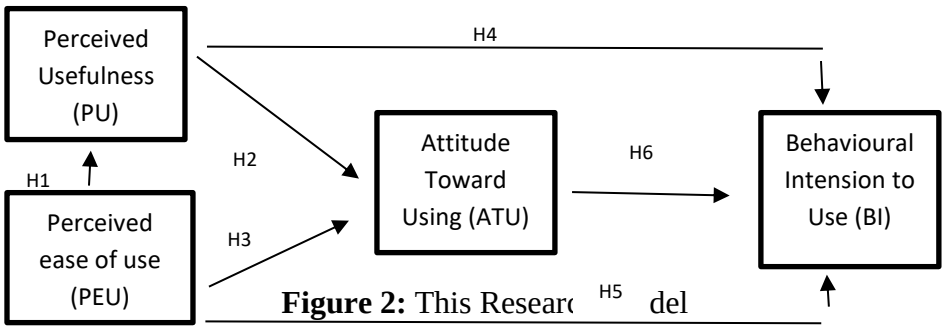


Figure 2: This Researc del

*(Source: Author's Own Survey***)**

3. Research Methodology

In this topic, methods involved in conducting this research are discussed together with the data analysis**.**

To test the hypothesis, a questionnaire was developed based on the attributes of the TAM model and literature review. Next, the AR images were systematically included in the notes which were then distributed to the lecturers. Together with that, a user manual and a video on how to use the AR were also sent to all the lecturers. Feedback, comments, and questions regarding the AR were then administered and answered thoroughly to make sure that all the lecturers know how to use it and can produce the output. These were also done in lectures selected for a pilot test. The questionnaire is divided into two sections, Section A contains the demographic information, and Section B contains constructs of PEOU, PU, ATU, and BI which are adapted to the context of AR image. The participants use Likert scale (i.e., 5= Strongly Agree, 4 =Agree, 3 = Neutral, 2 = Disagree, 1= Strongly Disagree)

After that, a pilot test was conducted to test the reliability of the questionnaire. About 9 lecturers were randomly selected who taught different subjects. The Cronbach's Alpha for each attribute was obtained using Statistical Package for Social Sciences (SPSS) software to confirm the internal consistency of each item. The next process is the distribution and data acquisition from the questionnaire. The data were collected after 7 days after distributing the AR image. This is to let the lecturers get used to the technology before answering the questions. There are about 40 lecturers who teach wireless communication nationwide. All 40 lecturers participated and responded to his questionnaire.

4. Data Analysis on Hypothesis Testing

Data obtained from the distributed questionnaire is then inserted into Statistical Package for Social Sciences (SPPSS) software for analysis. The hypothesis is tested using analysis using the same software. The analyses used here are the Pearson Correlation analysis and descriptive analysis.

4.1. Reliability Test: A reliability test is done on a small group of people to check the internal consistency of the questionnaire or instrument used. It is usually done before distributing to the actual sample of a population. The internal consistency is measured using Cronbach's alpha value. The value should be above 0.7 for a good interrelated questionnaire.

Table 1.1 shows the result of Cronbach's alpha for all 20 items. 0.755 shows the value is within the acceptable range. Meanwhile, for Table 1.2, Cronbach's alpha for separate constructs was obtained. From there, PU is 0.809, POEU is 0.806, ATU is 0.889 and finally BI is 0.800 which is considered the questionnaire can proceed.

Table 1: *Cronbach's Alpha for The Whole Items Using Statistical Package for the Social Sciences (SPPSS) Software*

Reliability Statistics

Cronbach's Alpha	N of Items
.755	20

*(Source: Author's Own Survey***)**

Table 2: *Cronbach's Alpha of Pilot Study for Each Item Using Statistical Package for the Social Sciences (SPPSS) Software*

Variables	Number of items	Cronbach's alpha
PU	7	0.809
POEU	7	0.806
ATU	2	0.889
BI	4	0.800

*(Source: Author's Own Survey***)**

4.2. Demographic Characteristics: Demographic characteristics are done to show what type of population the study is dealing with. Based upon Table 1.3 majority of the participants fall into the 41- 50 years of category, have a minimum master's degree, and have between 16-20 years of teaching experience in wireless communication subject.

Table 3: *Participants Profile Using Statistical Package for the Social Sciences (SPPSS) Software*

Characteristics		Frequency	Percentage (%)
Age	Below 31 years old	0	0
	31 - 40 years old	2	5
	41 - 50 years old	38	95
	Above 50 years old	0	0
Gender	Male	23	57.5
	Female	17	42.5
Academic Qualification	Master's Degree	37	92.5
	Doctoral Degree	3	7.5
	Below 6 years	0	0

Tertiary Teaching Experience	6 - 10 years	0	0
	11 - 15 years	3	7.5
	16 - 20 years	37	92.5
	Over 20 years	0	0

(Source: Author's Own Survey)

4.3. Pearson Correlation and Descriptive Results: Pearson Correlation is used to test how well two variables relate to each other. SPSS software tool is used to determine the dependency level between two variables and whether or not these two variables have a linear relationship or otherwise.

Table 1.4: *Pearson Correlation Analysis Using Statistical Package for the Social Sciences (SPPSS) Software*

		Mean_POEU		Mean_PU1	Mean_ATU	Mean_BI
Mean_POEU	Pearson Correlation	1		.766**	.823**	.796**
	Sig. (2-tailed)			.000	.000	.000
	N	40		40	40	40
Mean_PU1	Pearson Correlation	.766**		1	.706**	.715**
	Sig. (2-tailed)	.000			.000	.000
	N	40		40	40	40
Mean_ATU	Pearson Correlation	.823**		.706**	1	.928**
	Sig. (2-tailed)	.000		.000		.000
	N	40		40	40	40
Mean_BI	Pearson Correlation	.796**		.715**	.928**	1
	Sig. (2-tailed)	.000		.000	.000	
	N	40		40	40	40

(Source: Author's Own Survey)

Based on the result obtained from Pearson Correlation above, each of the hypotheses is tested.

- H1: PEOU will have a positive effect on PU.

There is a strong significant relationship between PEOU and PU. The correlation coefficient shows a value of 0.766 which is more than 0.7 which indicates a strong positive relationship. This supports the hypothesis and therefore it is retained.

- H2: PU will positively affect Malaysian polytechnic lecturers' (who teach wireless communication) attitudes toward using AR.

  There is a significant strong positive relationship between PU and ATU which has a Correlation Coefficient of 0.706. This supports the hypothesis, and therefore this hypothesis is retained.

- H3: PEOU will positively affect Malaysian polytechnic lecturers' (who teach wireless communication) attitude toward using AR.

  Based upon the result, the correlation coefficient between PEOU and ATU has a significantly strong positive relationship which is 0.823 and is higher as compared to PU and ATU. The hypothesis is accepted.

- H4: PU will have a significant positive effect on Malaysian polytechnic lecturers' (who teach wireless communication) behavioral intention (BI) to use AR.

  There is a strong significant positive relationship between PU and BI as the coefficient reveals a value of 0.715. The hypothesis is accepted.

- H5: PEOU will have a positive effect on Malaysian polytechnic lecturers' (who teach wireless communication) behavioral intention to use AR

  PEOU and BI have a significant positive strong relationship which is indicated by a correlation coefficient of 0.796. The hypothesis is accepted.

- H6: ATU will positively affect Malaysian polytechnic lecturers' (who teach wireless communication) behavioral intention to use AR.

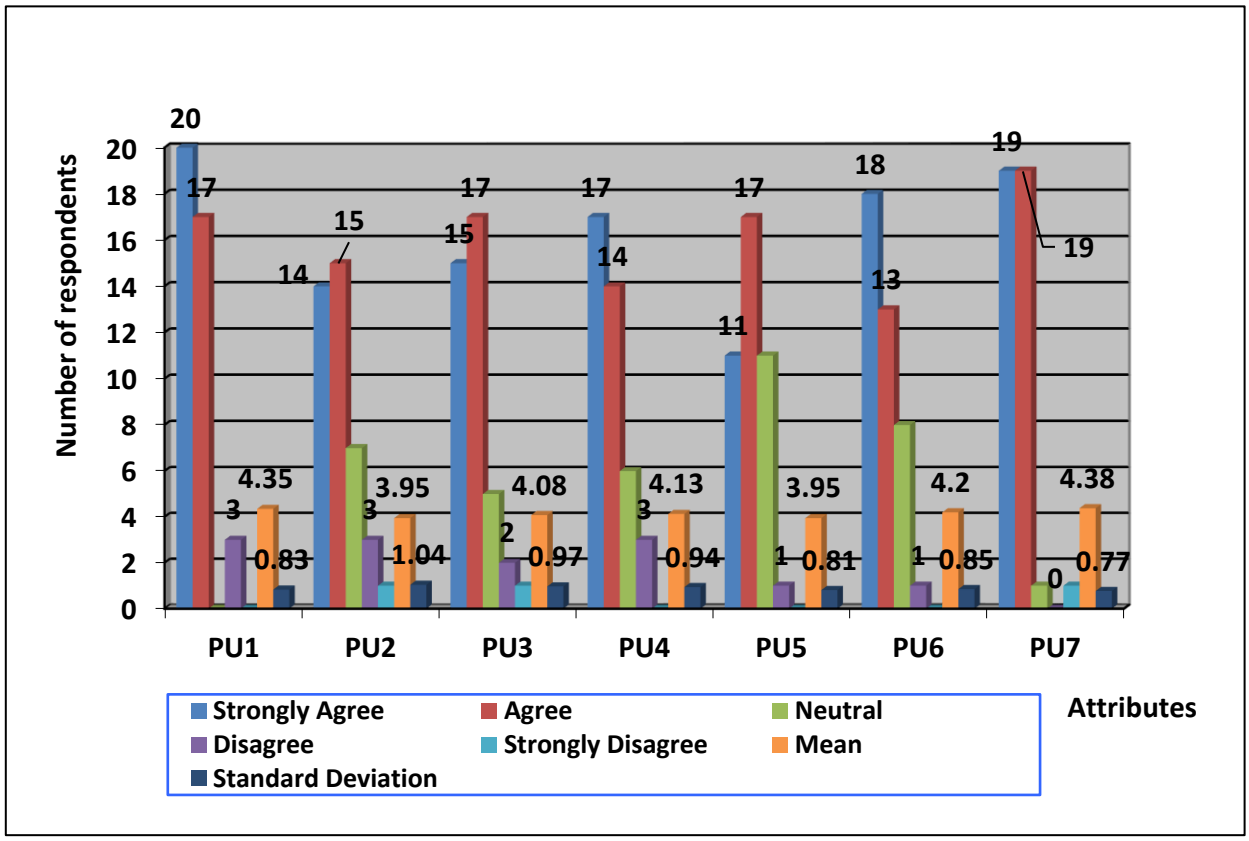
There is a significant strong relationship between ATU and behavioral intention to use among Malaysian polytechnic lecturers' (who teach wireless communication) on AR. The coefficient shows 0.928 which is the highest indication among other constructs on BI.

The results indicate that Perceived Ease of Use (PEOU) has a higher significant positive relationship with Behavioral intention to Use (BI) on AR as compared to Perceived Usefulness (PU) on Behavioral intention to Use (BI). As in the case of polytechnic lecturers being studied here, their preference and acceptance level of technology is much determined by how easily the technology can be used as compared to the level of usefulness. Meanwhile, the strongest positive

relationship can be seen between Attitude toward using (ATU) and Behavioral intention to Use (BI). Based on this, the acceptance level among Malaysian polytechnic lecturers who teach Wireless communication subjects in incorporating AR is high, as they believe it is easy to use followed by perceived usefulness.

Table 1.4, 1.5, and 1.6 shows statistical analysis in terms of frequencies and percentage are shown.

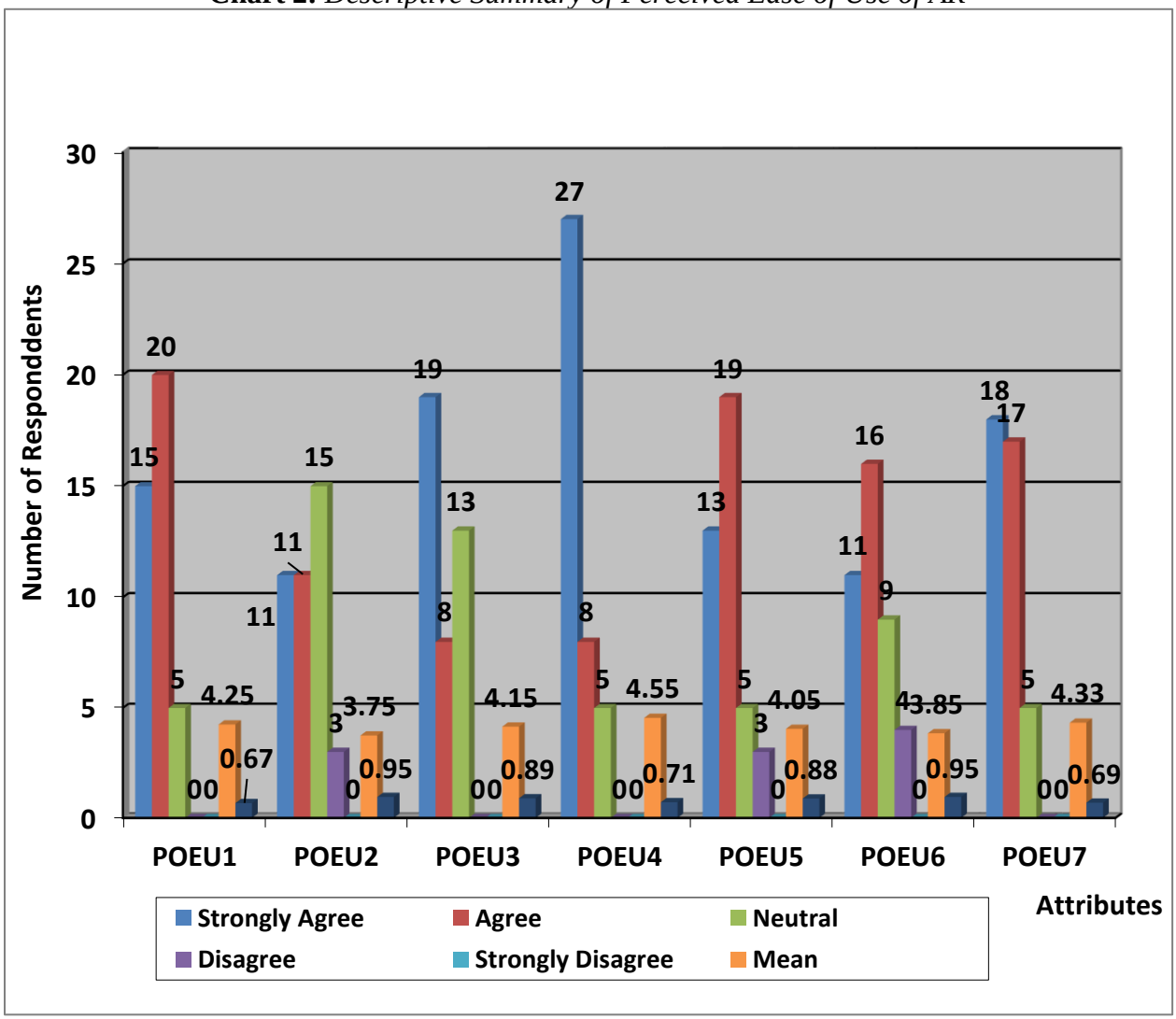
Chart 1: *Descriptive Summary of Perceived Usefulness (PU) of AR*



(Source: Author's Own Survey)

Respondents agree with all the same under the construct of Perceived usefulness. Among all the statements, the top 3 highest mean falls on PU7 (Overall implementing Augmented reality in most of the topics will be useful for students taking up wireless communication subject), PU1 (Using Augmented Reality (AR) will improve my student's learning quality in terms of remembering and recalling a concept), and PU 6 (Using Augmented reality will further use in making students visualize better). Perceived Usefulness refers to lecturers' opinion that AR will enhance their job performance which in this case is achieving their student learning outcome.

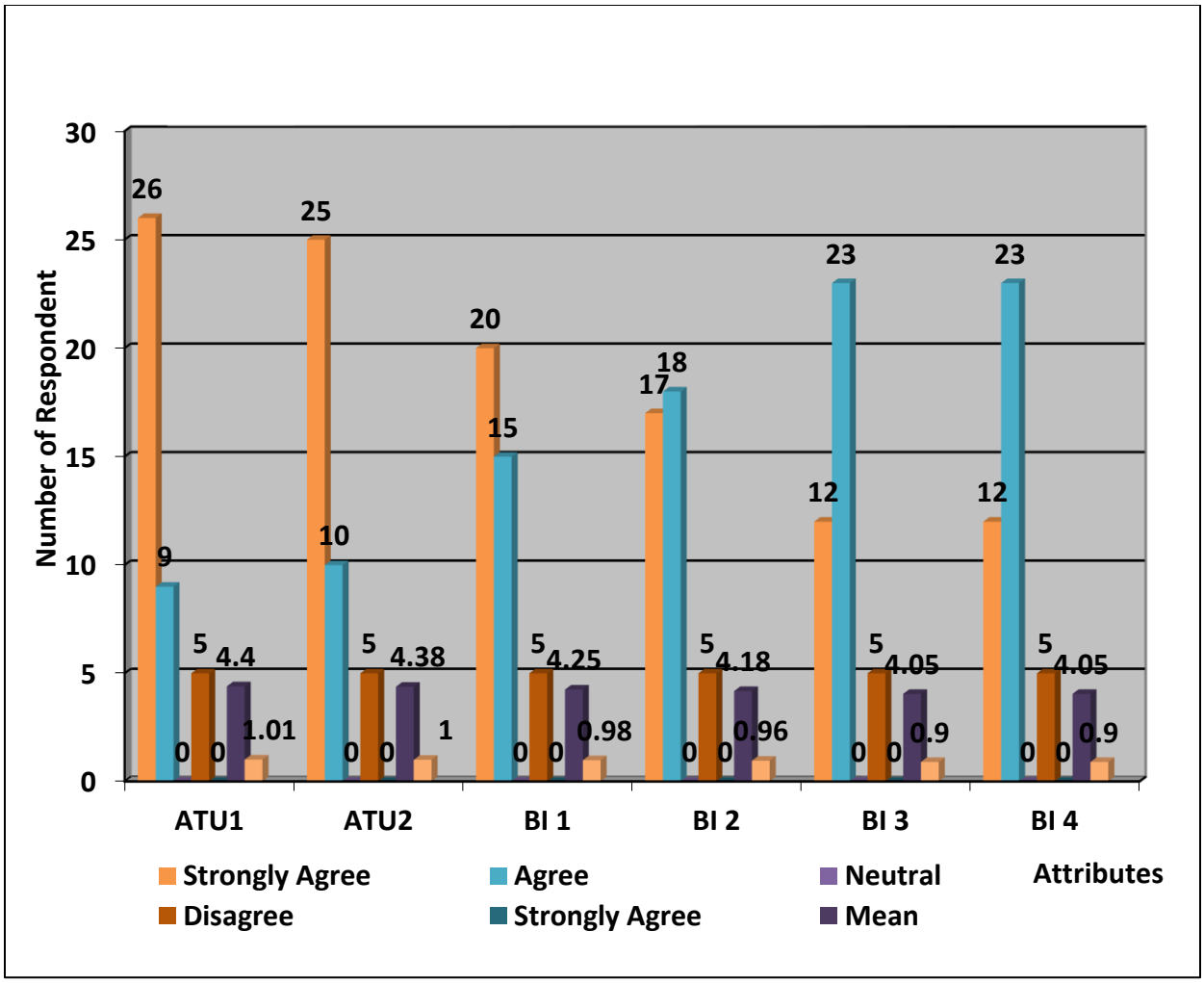
Chart 2: *Descriptive Summary of Perceived Ease of Use of AR*



(Source: Author's Own Survey)

Based on the above statistical data, the highest mean falls on POE4 (My interaction with AR image is clear) which is 4.55, followed by POEU 7 (Overall I believe AR is easy to use in my class) which is 4.33, and finally POEU 1 (Using Augmented Reality (AR) application is easy for me). However, POEU2 (It is easy to get an Augmented Reality image out in front of my camera) is neutral. The smoothness of interactivity depends also on the internet connectivity and the type of phone being used. Perceived Ease of Use refers to the lecturers' opinion on how effortless to use the AR.

Chart 3: *Descriptive Summary of ATU and BI on AR*



(Source: Author's Own Survey)

Based on the result, both ATU statements show a high mean on Strongly Agree. For BI the highest mean goes to 4.25. According to the TAM model, a high mean of BI indicates lecturers have plans and intentions to use it in the future (Davis, 1989). The results from Chart 3 confirm that 87.5% of Malaysian polytechnic lecturers (who teach wireless communication subject) lecturers strongly agree and agree to have a positive attitude towards (ATU) using AR. The result further confirms that 87.5% of polytechnic lecturers who teach wireless communication subjects in Malaysia have the intention of using AR hence they will accept the AR technology introduced in the wireless communication subject. This study also proves the TAM model that their behavioral intention is caused by their positive attitude towards it. This study also supports the research model as shows that the respondents believe of ease of use will also determine the intention of use (hypothesis 5).

5. Conclusions and Discussion

This study confirms the previous study's findings of applying TAM to predict the possible acceptance of technology. The data analysis indicates that about 87.5 % of Malaysian polytechnic lecturers who teach wireless communication subject currently accept the AR technology incorporated into that subject. The limitation of this study is that the study only focuses on lecturers who teach wireless communication subjects. Other subject lecturers' acceptance level on AR is not catered to here.

Augmented technology can be introduced as it gives a diverse teaching method that is in line with the current young generation. It will provide a way towards IR 4.0 as they get exposed to this technology during their study life itself.

However, the scope of future research can be extended by adding Augmented Reality in the form of animation to further explain on areas of wireless communication. Moving characters popping out of mobile screens can give excitement to students during teaching and learning activities in classrooms.

REFERENCES

Abdullah, N., Baskaran, V., Mustafa, Z., Ali, S., & Zaini, S. (2022). Augmented Reality: The Effect in Students' Achievement, Satisfaction and Interest in Science Education. International Journal of Learning, Teaching and Educational Research Vol.21 No:5. https://doi.org/10.26803/ijlter.21.5.17

Abu Bakar, S., Othman, N., & Nasir, A. (2022). User Acceptance and Usability of Augmented Reality (Ar) Polimas Tour. Journal on Technical and Vocational Education Vol 7 No 1.

Alejandro Álvarez-Marín, J. Ángel Velázquez-Iturbide 2, & Mauricio Castillo-Vergara. (2021). Technology Acceptance of an Interactive Augmented Reality App on Resistive Circuits for Engineering Students. Electronics. https://doi.org/10.3390/electronics10111286

Anuar, S., Nizar, N., & Ismail, M. (2021). The Impact of Using Augmented Reality as Teaching Material on Students' Motivation. Asian Journal of Vocational Education and Humanities Vol. 2 No. 1.

Ayman A. A. (2014). Accepting Moodle by academic staff at the University of Jordon: applying and extending TAM in Technical Support Factors. European Scientific Journal edition vol.10, No.18.

Boudebza M. (2017). The impact of a proposed educational program using the mini-games to improve. 15th International Conference on Teaching, Education, and Learning (ICTEL), 14-15.

Carmigniani, J., & Furht, B. (2011). Augmented Reality: On Overview. In Handbook of Augmented Reality. Springer. https://doi.org/10.1007/978-1-4614-0064-6_1

Darren, Y., EongPoh, P., & YingTang, S. (2022). Assessing the impact of augmented reality application on students' learning motivation in chemical engineering. Education for Chemical Engineers Volume 39, Pages 31-43. https://doi.org/10.1016/j.ece.2022.02.004

Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. MIS Quarterly Vol. 13, No. 3, 319-340. https://doi.org/10.2307/249008

Dianah S. A. B., Selamat, A., Krejcar, O., Maresova, P. & Thanh N. N. (2020). Digital Learning Demand for Future Education. Informatics 2020, 7, 13. https://doi.org/10.3390/informatics7020013

Fussell, S. G. & Truong, D. (2021). Using virtual reality for dynamic learning: an extended technology acceptance model. Virtual Reality volume 26. https://doi.org/10.1007/s10055-021-00554-x

Gavaldon-Hernandez G., Gerboles-Sanchez, A., & Saez de A. F. (2017). Use of digital graphic narratives with preservice teachers as a mediated learning. 15th International Conference on Teaching, Education, and Learning (ICTEL), 19.

Gurevych, R., Silvester, A., Mokliuk, M., Shaposhnikova, I., Gordiichuk, G., & Saiapina, S. (2021). Using Augmented Reality Technology in Higher Education Institutions. Postmodern Openings Vol. 12 Issue 2, p109-132. 24p. https://doi.org/10.18662/po/12.2/299

Hui-Tzu H. & Chih-Cheng L. (2021). Extending the technology acceptance model of college learners' mobile-assisted language learning by incorporating psychological constructs. British Journal of Education technology.

Johar, S., & Abdullah, N. (2019). Pembangunan e-Modul Augmented Reality bagi Subjek Semiconductor Devices untuk Guru TVET. Online Journal for TVET Practitioners Vol 4 No. 2.

Leung, W. S. & Blauw, F. F. (2020). An augmented reality approach to delivering a connected digital forensics training experience. Information Science and Applications. https://doi.org/10.1007/978-981-15-1465-4_36

Oyman, M. Dondu, B. & Serhat O. (2022). Extending the technology acceptance model to explain how perceived augmented reality affects consumers' perceptions. Computers in Human Behavior Volume 128. https://doi.org/10.1016/j.chb.2021.107127

Papakostas, C., Troussas, C., Krouska, A., & Tsioropoulos, C. (2022). User acceptance of augmented reality welding simulator in engineering training. Education and Information Technologies, 791–817. https://doi.org/10.1007/s10639-020-10418-7

Salwa, A., Nurhuda N. & Muhamad A. I. (2021). The Impact of Using Augmented Reality as Teaching Material on Students' Motivation. Asian Journal of Vocational Education and Humanities Vol. 2 No. 1.

Tolba, R., Elarif, T. & Fayed, Z. T. (2021). Augmented Reality in Technology-Enhanced Learning: International Journal of Intelligent Computing and Information Sciences Vol.22, No.1, 44-59. https://doi.org/10.21608/IJICIS.2022.97513.1121

Vásquez-Carbonell, M. (2022). A Systematic Literature Review of Augmented Reality in Engineering Education: Hardware, Software, Student Motivation & Development Recommendations. Early Childhood and Technologies at School and Home No. 41. https://doi.org/10.1344/der.2022.41.249-267

Zulfabli, H. M., Ismalina, H. N., Amaral, T., & Ahmad, S. (2019). Product development of mechanical practice: Augmented reality (AR) approach. AIP Conference Proceedings Volume 2129, Issue 1. https://doi.org/10.1063/1.5118063