Investigating Moderating Influence of Gender on Augmented Reality and Students Satisfaction: Experiences in Cultures and Linguistic Diversity

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Abstract: The study aimed to examine the moderating role of gender in the adoption of augmented reality and student satisfaction. A quantitative approach was applied, and data were collected from 196 foreign students who were studying in a Malaysian university. Based on user acceptance of technology, the relationship between augmented reality and students' satisfaction was investigated via structural equation modelling. The results indicated that students were satisfied with augmented reality with positive effects on their learning interaction. Further findings revealed that male students postulated higher satisfaction and stronger relationships in using augmented reality than female students. The study ascertained the strength of the hypotheses that revealed the acceptance of augmented reality by students in Malaysia institutions of higher learning and affirmed gender as a moderating variable to students' satisfaction in augmented reality usage.

Keywords: Augmented Reality, Second Language, Cultures and Linguistic Diverse, Student Satisfaction

1. Introduction

Over the last decade, the internationalisation of learning and teaching has been one of the most critical objectives for tertiary institutions around the world. However, ethnic difference has been another challenging issue for education systems in general as different ethnic minorities and indigenous groups demand greater recognition of their cultural and linguistic rights (Bianco & Slaughter, 2016). It is highly imperative for higher education institutions to find a long-lasting solution to support learners whose ethnic barrier becomes a constraint to learning (especially among culturally and linguistically diverse learners (CALD) students (Baker at al., 2021). Numerous studies have demonstrated that the unique requirements of these students, as well as learning and teaching circumstances where a sizable number of students come from varied backgrounds, impose extra demands on lecturers and institutions (Baker et al., 2022; Christou & Fragouli, 2018; Rowan et al., 2021; Stone et al., 2022). Thus, the most critical factor to `CALD student survival must involve a management policy put in place with regards to the adaptation of these foreign students to new environment, new cultural practices, and expectations in order to attract and retain them (Silwal, 2022; Yarlagadda et al., 2018). Hence, countries with large numbers of international students face

significant cross-cultural challenges and need to scrutinise their teaching and learning strategies to keep up with increasing internationalisation (Hanife et al., 2020; Ghosh, 2022). In light of this, teachers and institutions must reconsider their approach to student learning to support CALD learners.

In the field of technology, Augmented Reality (AR) technology has been seen as a commendable development and practical instrument (Rini et al., 2022), which involves technology enhanced learning through the use of supplementary tools to combine reality with virtual learning (Neffati et al., 2021). According to Saleem (2021) and Enzai et al., (2020) applications for augmented reality are a cutting-edge e-learning innovation that accelerates student learning in virtual classrooms. The combination of reality and virtual images and several virtual stimuli in Augmented Reality (AR) technology enhance effective teaching and participatory learning as it attracts learners' attention and assists them in proper processing of information (Liao, 2019; Saleem, 2021). Previous scholars in the field of education have concurred that AR technology is a distinct learning and teaching medium (see Bursali & Yilmaz, 2019; Neffati et al., 2021; Vasilevski & Birt, 2020; Rini et al., 2022; Wang at al., 2018) which offers instructors with opportunities to create an interactive learning session and student-oriented teaching process. It also facilitates effective understanding of scientific and experimental contents.

The adoption of AR technology is imperative for teachers and instructors (Koutromanos & Mavromatidou, 2021, Kaliyaperumal et al., 2020) as it allows the integration of technology in the learning process (Sáez-López et al, 2020). Adoption of advanced technology also enhances management of diversity among students as it provides tools for accelerating conceptual and linguistic development. It also facilitates participation and interaction among students during their course of learning (Shafie et al., 2019). Electronic resources have contributed immensely to the field of education as it has changed methods of teaching over the internet (Gupta & Pathania, 2021) through graphics, video and audio clips and interactive boards for more effective teaching methods (Krishnan et al., 2020). These technological devices serve as augmented tools to enhance the learning process (Raja & Lakshmi Priya, 2022).

Recently, countries around the world have faced the biggest demographic change, including cultural and linguistic diversity (Laitin & Ramachandran, 2022). Malaysia, like many other countries, is becoming more multicultural (Masiran, 2022). In the past decade, Malaysia, which is considered one of the most-popular study destinations in Asia for foreign students, experienced an increase in the number of students whose first language was not English (Fujimoto-Kaneko, 2021) especially in private institutions. In fact, it is not a new phenomenon that international students are enrolled at Malaysian education institutions; International students have been enrolling in Malaysia for more than two decades in order to study in a safe and friendly environment, as well as to receive a high-quality education thus boosting their chances of finding job in their home nations (Kaneko, 2020). As the number of students increases, the sustaining of students with diverse cultures and linguistics (CALD) has become an important issue in Malaysia (Yassin et al., 2020).

Evidently, the statistics of CALD students continues to increase in Malaysia, and an estimated 56,700 of international students had enrolled in Malaysia in 2020. Among these international students mentioned above, students from five countries top the list of enrolled international students. These include China 13.45, Indonesia 9.34, Bangladesh 7.74, Yemen, 6 and Pakistan 5.15 (International Student Data, 2020). The international students from various cultures and languages were enrolled in a wide range of courses across the universities, reflecting how diversified the students are, and the need for AR technology to enhance effective learning experiences among them. Baker et al (2021) implied that there are various issues faced by CALD learners in universities which reflect a negative effect on their learning. Savva (2017), Moloney and Saltmarsh (2016), Baker et al (2021) determined the issues include cultural differences, language problems, lack of responsiveness from their university, inconsistent teaching and learning expectations, loneliness, social isolation, teacher perception and attitude toward teaching and culturally and linguistically diverse classroom within undergraduate teacher education programmes. All these issues can have a significant impact on academic outcomes of CALD students.

The diversity among learners in the country makes it imperative for instructors and institutions to adopt technology-enhanced teaching tools. Obviously, cultural and linguistic diversity can affect the learning experience, and as such participants in the learning process need to keep abreast of CALD issues. Consequently, higher education institutions around the world are continuing

to establish online learning options for their staff and students (Fabian et al., 2022; Sim at al., 2021). This change is proving to be challenging for both students and educators who are expected to adapt to online teaching from remote locations, from the traditional face-to-face interactions in the classroom to a lack of social contact. This transition has warranted higher education institutions to shift their focus towards effective delivery of online learning education (Olowoselu, 2023). Hence, there is a need for a paradigm shift towards educational strategies and support to ensure effective teaching and learning experiences which accommodate cultural and linguistic differences among students of higher institutions in the online platform.

A number of studies have been conducted in developed countries, particularly the United States and Europe, that have examined the impact of augmented reality adoption on higher education (Johnson et al., 2020; Basak et al., 2020). Nevertheless, there has been limited research into how AR enhances educators' ability on CALD learners' support. Therefore, this study focuses on how AR technology affects CALD student's learning satisfaction in relation to the moderating role of gender.

2. Theoretical background

2.1 User Acceptance of Technology

Technology Acceptance Model (TAM) has been used to examine students' acceptance of technology which is a significant factor that directly influences students' perceptions about augmented reality for their learning. Davis (1985) proposed TAM and regarded it as a theoretical framework to decide an individual's acceptance of technology use. For the purpose of investigating the factors that determine an individual's acceptance of technology, attitudes towards technology are considered to be a crucial determinant of an individual's behavioural intention to apply technology (Davis et al. 1989). The TAM shows that behaviour could be predicted straightforwardly from behavioural intentions, which partially connects to people's attitudes towards their behaviour (Chen & Tsai, 2019).

In TAM, four important variables are presented, one is perceived ease of use, perceived usefulness, perceived enjoyment and attitude towards use (Mohd Amir et al., 2020). Extensive experience with intention measures in other contexts has consistently supported their role as predictors of an individual's behaviour. Here, perceived usefulness as well as ease of use ought to be essential elements to foreign students since these are essential components related to online learning (Olipas & Leona, 2022).

Furthermore, TAM is regarded as a reliable model for predicting intention in the use of e-learning systems among technological models. In the educational sector, TAM has undergone testing and validation to anticipate learners' intentions. TAM with important variables has subsequently been researched in several states to forecast the occurrence of behavioural intention. Therefore, based on the aforementioned purpose which is related to the current study, augmented reality influences students' satisfaction which in turn has impact on their actual performance. When teachers' have the ability to enhance students' satisfaction, they will hold a stronger intention to adopt it, as a result, they are more likely to use it.

2.2 Related Literature

Culturally and linguistically diverse (CALD) is predominant across states in Malaysia, which is a host country for many African, Asian, and Arabian international students. Most of the international students are from war-torn economies. Hence, it becomes imperative for these students with diverse languages and cultures to receive support to ensure equity in high-quality education across students of various colours, races, and cultures. Furthermore, instructors are required to use high-impact technology that could have a far-reaching impact on international students.

Recently, the advent of technology has changed the learning procedures to support students and improve their effectiveness and efficiency globally (Collins & Halverson, Du et al., 2021; Hsu et al., 2020; Lawrence & Tar, 2018; Viberg & Gronlund, 2017; Wang & Jou,2020). Issues relating to cultural scaffolding and advanced technology aimed at enhancing and eliminating the language barrier

in institutions of learning has gained popularity among researchers in the field of education and technology (Kryachkov et al., 2015; Qureshi et al.2022).

2.2.1 Literature Review on CALD

Diversity in student populations across the globe has challenging implications for classroom conduct. Students encounter difficulties in making inquiries, participating in classroom activities, and relating with other students of diversity. Hence, several studies have examined issues of culturally and linguistically diversified studies (Haan et al., 2017; Hadjioannou et al., 2016; Moloney & Saltmarsh, 2016; Park at al., 2016).

Han et al. (2017) revealed a relatively low level of self-efficacy in teaching international students with diverse cultures and languages in private and public universities. Similarly, Savva (2017) also found a significant relationship between personal and professional changes in classroom instruction. The study also identified transformation in the areas of communication style, gender, and religious consideration in the classroom where diversity exists.

The findings of Moloney and Saltmarsh (2016) revealed mixed feelings and skepticism of the instructors to teach culturally and linguistically diversified students in the undergraduate teacher education program. The findings also revealed the rigidity of the curriculum and its failure to incorporate the needs for learning related to culturally and linguistically diversified students. Similarly, the study of Hadjioannou et al. (2016) suggested participation in an e-learning module program known as Modular Design for English Language Learner (MODELL) to improve participant knowledge of language and literacy acquisition simultaneously.

Several studies have revealed the importance of augmented reality technology such as Google class, Hololens, and Google Cardboard in imparting knowledge and overcoming problems of diversity across e-learning platforms (Atasoy at al., 2017; Akcayir & Akcayir, 2016; Bursali & Yilmaz, 2019; Dibrova, 2016; Enzai at al., 2021). While the AR technology stimulates the teaching experience (Bursali & Yilmaz, 2019). it also assists and motivates students in their accomplishment, and makes the educational process accessible to them (Bursali & Yilmaz, 2019; Goktas & Gulcu, 2017).

While some studies employed a systematic review of extant literature in different contexts (Bursali & Yilmaz, 2019; Goktas & Gulcu, 2017), they all arrived at the similar conclusion that augmented reality is vital in enhancing students' conceptual understanding as well as motivating them (Akcayir & Akcayir, 2017), improving students' performance (Afandi at al., 2019), enhancing STEM education (Sirakaya, & Sirakaya, 2020), and reducing students' anxiety (Bursali & Yilmaz, 2019).

Based on the review of the existing literature, the researcher found gaps in the concept. Most of the existing literature failed to consider the role of the environment in augmented reality technology. However, this present study shall fill identified gaps by focusing on culture and linguistically diverse learners in a more natural environment. Furthermore, this study shall examine and investigates the role of gender in the adoption of augmented reality and student satisfaction. Recent works have examined the ability of teachers and institutions to support CALD learners in a traditional mortar and brick classroom environment. However, this study is going to expand the frontiers of knowledge by investigating the various ways teachers and institutions of learning could support culturally and linguistically diversified students in the online classroom environment.

This study also expands the knowledge field in the field of diversity management by examining the role of AR technology in the classroom settings. Similarly, the unique methodology shall also allow the inclusion of a diverse range of cultural and linguistic issues that are absent in existing literature. It is therefore essential to fill existing gaps in the literature by seeking targeted support and scaffolding to ensure equal access to quality education for Malaysian CALD learners.

2.2.2 Student Satisfaction

To measure how satisfied students are with their learning experiences both in regular classrooms and online, numerous studies have been conducted. According to Dziuban et al., (2004), students satisfaction is high when they are able to communicate effectively, are supported or encouraged during their learning, when courses are planned efficiently, when instructors show interest

in students' learning and progress, and treat them and their work with an accurately assessed respect. Bangert (2006) identified four factors, including time spent on task, active and engaged learning, peer cooperation, and engagement and communication between students and instructors, that affect student satisfaction in online courses.

Mohammed et al., (2022) demonstrated that it is critical to assess how student participation affects outcomes like satisfaction, which have an impact on attitudes. Student satisfaction ratings enable institutions to research ways to develop and improve their online courses, and they are also related to retention and willingness to finish the course (Alqurashi, 2019& Mohammed et al., 2022). Therefore, it is crucial to conduct research to provide more information about how acceptance of augmented reality influences CALD students' satisfaction in order to inform the design of more satisfying augmented reality.

2.2.3 Gender

Gender was taken into account as a moderator variable in the design of the current study. According to Baron and Kenny (1986) quantitative study that modifies the significance, direction, and/or strength of the association between two other factors is known as a moderator variable. By incorporating mitigating factors like gender, the literature on augmented reality adoption and student satisfaction is improved (Abed, 2021 & Basak et al., 2020). Tarhini et al., (2014) reported that the addition of gender as a moderator has enhanced the TAM by 52%.

Prior studies revealed significant gender variations in important adoption and acceptance variables for technology (Basak et al., 2020; Harvey et al., 2017; Tarhini et al., 2014; Lakhal & Khechine, 2021). It was shown that, despite spending more time and engaging in online activities than men, women lack confidence (Mahmodi & Ebrahimzade 2015). Furthermore, Krajewski (2015) discovered a negligible link between gender and perseverance in online courses. Another important finding revealed that when it comes to adopting e-learning usage, female learners are more concerned than male learners (Shahzad et al., 2021).

Although previous research points towards men being perceived as better online learners than women (Okazaki et al., 2012, the literature depicts insufficient research in investigating individual differences in the context of Malaysia. Meanwhile, the addition of individual differences as moderators has increased the power of TAM evaluation. To fully understand the adoption of this phenomena, it is important to consider the impact of individual differences on student satisfaction (Harvey et al., 2017). Therefore, this study investigates the role of gender in the adoption of augmented reality and student satisfaction.

Research Objectives

1- To examine the influence of perceived ease of use of augmented reality on students' satisfaction.
2- To examine the influence of usefulness of augmented on students' satisfaction.
3- To examine the influence of perceived enjoyment of augmented reality has a positive influence on students' satisfaction.
4- To examine the influence of attitude to use augmented reality has a positive influence on students satisfaction.
5- To investigate the moderating influence of gender on relationship between the acceptance of augmented reality and students' satisfaction.

3. Research hypotheses

H1: Perceived ease of use of augmented reality has a positive influence on students' satisfaction.
H2: Perceived usefulness of augmented reality has a positive influence students'satisfaction.
H3: Perceived enjoyment of augmented reality has a positive influence on student satisfaction.
H4: Attitude to use augmented reality has a positive influence on student satisfaction.
H5: The positive relationship between the acceptance of augmented reality and student satisfaction would be stronger for male compared to female.

4. Methodology

4.1 Sample size and data collection

196 CALD students from a compulsory English course were recruited from several universities in Malaysia. In this study, the sample size was determined by using the G-power sampling size determinant. The main prediction in the model for this investigation were five. Utilizing G-power with an effect size of 0.15, an alpha of 0.05, and a power of 0.8, the minimal sample size needed was only 102. As a result, we can draw the conclusion that our study's sample size of 196 has a power of more than 0.9 positing the finding at confidence level. The demographic analysis confirmed that the sample comprised 78 (38.8%) females and 118 (60.2%) males. They were all international students from various countries (14.8% Libyan, 16.8% Iraqis, 19.9 % Yemenis, 11.7% Algerian, 11.7% Egyptian, 12.8% Jordanian and 12.2 were others). The final version of the structured questionnaire was distributed to this sample of 196 students.

4.2 Measurement of variable

The online survey questionnaires used in this investigation contained items related to the research constructs, and the study used a cross-sectional research methodology. The scale used for augmented reality had been devised by Davis (1989) and modified and validated by Cabero-Almenara et al. (2019). The student satisfaction scale consisted of five items adapted from Kuo et al. (2014). Each original English questionnaire was translated into Arabic, the language of the Arab nation, using Brislin's back-translation with decentring method (1986). An Arab researcher who speaks both languages well provided the back translation. Language specialists were consulted to settle any differences between the translated versions that were discovered. All items of employed constructs were measured on a six Points Likert Scale ranging from strongly disagree to strongly agree.

4.3 Data analysis and Result

As recommended by Cain et al. (2017), multivariate normality was assessed using the online software, https://webpower.psychstat.org/models/kurtosis/, because the data were gathered through a survey. The Mardia’s coefficient of multivariate skewness was 7.326 and kurtosis was 48.0133, suggesting that the data was not multivariate normal. Consequently, the proposed model was tested via bootstrapping utilising partial least square-structural equation modelling (PLS-SEM) with SmartPLS 3.3.3 (Ringle et al., 2015). According to Hair et al., 2019 and Ramayah et al., 2018, the structural model should be examined after the measurement model.

Given that our study's data came from a single source, a full collinearity assessment was carried out as advised by Kock and Lynn (2012) to address the problem of common method bias (CMB). All the constructs (including the dependent variable) were regressed in the research model against this common variable after creating a dummy variable using Excel's random function. The findings in Table 1 reveal that there was no serious concern and was not existing because none of the VIFs exceeded the critical value of 3.3.

Table 1. Fully collinearity test

Constant	PEU	PE	PU	AU	SA
VIF	1.567	1.535	1.726	1.642	1.995

Note: PEU= perceived enjoyment, PE= perceived ease of use, PU=perceived usefulness, AU= attitude towards use, SA= student satisfactions.

4.4 Measurement Model

In accordance with a suggestion by Anderson and Gerbing's (1988), a two-step procedure was used to test the constructed model. First, the measurement model was examined to test the validity and reliability of the instruments using following guidelines of Hair et al. (2019) and Ramayah et al. (2018). Then, to test the developed hypothesis the structural model was used.

The loadings, average variance extracted (AVE), and composite reliability (CR) for the measurement model were evaluated. The CR should be greater than 0.7, the AVE should be greater than 0.5, and the loading values should be greater than 0.5. The AVEs and CRs were all greater than 0.5, as indicated in Table 2, and they were all greater than 0.7. Additionally, the loadings were suitable (Hair et al., 2019).

Table 2. Measurement model

1st Order	2nd Order	Items	Loading	CR	AVE
Perceived Ease of Use (PEU)		PEU1	.749	0.803	0.577
		PEU2	.792		
		PEU3	.735		
Perceived Enjoyment (PE)		PE1	.744	0.801	0.573
		PE2	.780		
		PE3	.747		
Perceived Usefulness (PU)		PU1	.801	0.804	0.580
		PU2	.814		
		PU3	.661		
Attitude Towards Use (AU)		AU1	.762	0.816	0.596
		AU2	.784		
		AU3	.770		
Students Satisfactions (SA)		SA1	.668	0.816	0.527
		SA2	.728		
		SA3	.811		
		SA4	.689		
	Augmented Reality (AR)	PEU	.760	0.849	0.584
		PE	.724		
		PU	.784		
		AU	.787		

Note. SA5 was deleted to assess the convergent validity requirement

In the second step, the discriminant validity using the HTMT criterion was evaluated as recommended by Henseler et al. (2015) and modified by Franke and Sarstedt (2019). The tighter condition is that the HTMT values must be less than either 0.85 or 0.90. (the mode lenient criterion).The values of HTMT were all lower than the stricter criteria of 0.85, as indicated in Table 3. As a result, it can be said that the respondents were aware of the distinctions between the five conceptions. These validity checks as a whole demonstrate that the measurement items were accurate and dependable.

Table 3. Discriminant validity (HTMT).

	1	2	3	4	5
1 Attitude Towards Use					
2 Perceived Enjoyment	0.716				
3 Perceived Ease of Use	0.654	0.611			
4 Perceived Usefulness	0.764	0.541	0.791		
5 Students Satisfactions	0.756	0.795	0.766	0.839	

4.5 Structural Model

The structural model defined the causal connections between the model's constructs. The bootstrapping sub-samples with 5,000 cases recommended by Hair et al. (2019) were used to construct the path coefficients and their corresponding t-values and p-values in order to assess the given research hypotheses. Additionally, Hahn and Ang (2017) suggested utilising a variety of criteria, such as p values, confidence intervals, and effect sizes, in their argument that p values are not a good criterion for testing the significance of hypothesis. Table 4 provides a summary of the criteria used to evaluate the established hypotheses. The effect of the predictors on students' satisfaction was tested. The R^2 was 0.501 (Q2 = 0.470), which shows that all the predictors explained 50.1% of the variance in students' satisfaction. The result revealed that perceived ease of use (β= 0.210, $p < 0.05$), perceived usefulness ($\beta = 0.283$, $p < 0.05$), perceived enjoyment ($\beta = 0.293$, $p < 0.05$) and attitude to use ($\beta = 0.129$, $p < 0.05$) were all positively related to students' satisfaction, thus H1, H2, H3 and H4 were supported.

Table 4. Hypothesis testing

Hypotheses	**Relationship**	**Std.Beata**	**Std.Error**	**t-value**	**p-value**	**BCI LL**	**BCI UL**	**F^2**	**Q^2**
H1	PEU→SA	0.210	0.070	1.831	p<0.05	0.108	0.304	0.060	0.470
H2	PU→ SA	0.283	0.068	4.168	p<0.05	0.175	0.395	0.103	
H3	PE→ SA	0.293	0.080	3.666	p<0.05	0.172	0.431	0.128	
H4	AU→ SA	0.129	0.070	1.831	p<0.05	0.019	0.249	0.021	
H5	AR→G→SA	0.082	0.046	1.772	p<0.05	0.013	0.163	0.023	

p<0.05 (t=1.645).

The study used the product-indicator approach to test the moderating effect, as recommended by Henseler and Fassott (2010). The study created the interaction term between augmented reality and gender role. The interaction effect was significant ($\beta = 0.082$, $p< 0.05$). Thus, H_5 of this study was moderated. The effect size f2 as suggested by Cohen (1988) was 0.023, which is considered small effect, suggesting that future studies should examine this construct with more reliable items. As Dawson (2014) suggested, we plotted the interaction effect to see how the moderator (gender role) changes the relationship between augmented reality and students' satisfaction. The result is shown in Fig.1. The relationship between augmented reality and students' satisfaction was stronger with males being higher than females.

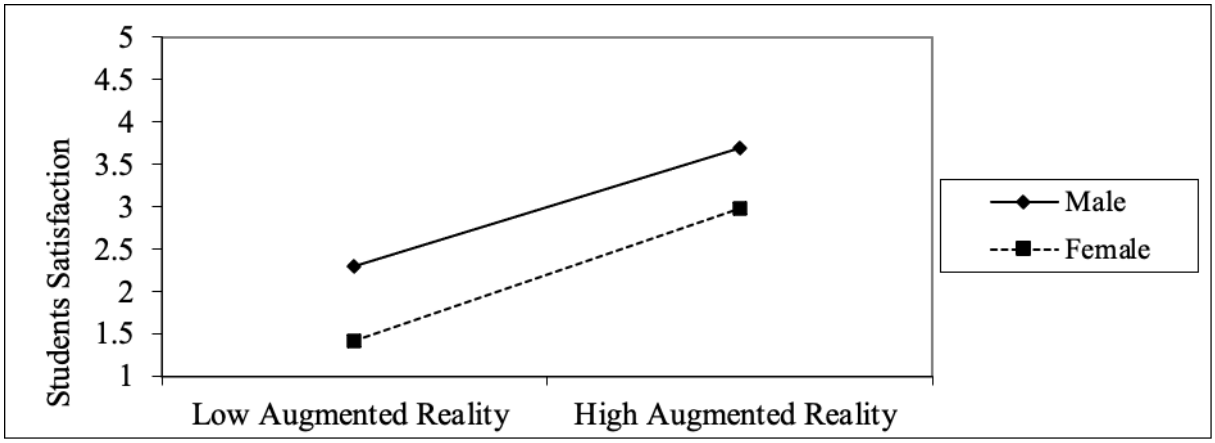

Fig.1 Interaction plot

5. Discussions

The purposes of this paper were to determine the moderating role of gender in the augmented reality and students' satisfaction. The findings revealed a significant relationship between perceived ease of use of augmented reality and students' satisfaction. The finding is in line with previous research findings of Bursali and Yilmaz (2019) and Goktas and Gulcu, (2017) as they revealed that augmented reality motivates and enhance students' accomplishment and makes the educational process easier and accessible. This finding affirmed that students are satisfied in ease of using augmented reality platform in their learning process. Therefore, it is important for students to embrace augmented reality in their educational development process.

Additionally, H2 established a significant relationship between perceived usefulness of augmented reality and students' satisfaction. The result of this research is in congruence with the study of Tosik-Gün and Kocaman-Karoglu, (2017), Dibrova, (2016), Bursali and Yilmaz (2019) as they comprehend the usefulness and importance of augmented reality technology in imparting knowledge and overcoming problems of diversity across e-learning platforms. In line with this outcome, this finding confirmed that students should inculcate the usefulness of augmented reality in their research and learning. Hence, it can even be considered the most important on the basis that it can be easily assessable and useful in their learning process.

Moreover, H3 revealed a significant relationship between perceived enjoyment of augmented reality and students' satisfaction. The result of this study is consistent with the study of Bursali and Yilma (2019) as they revealed augmented reality technology stimulates the teaching experience. This means that students enjoyed and were satisfied using augmented reality platform in learning. Assuredly, this finding further laid credence with the findings of Afandi et al., (2019) as they affirmed that augments learning and most appropriate for students to improve their learning satisfaction.

Similarly, H4 established a significant relationship between attitude to use augmented reality and students' satisfaction. This finding is in agreement with the finding of Akcayir & Akcayir, (2017) as they affirmed students use of augmented reality in enhancing their conceptual understanding as well as motivational attitude towards learning. This finding further confirmed the importance of student attitude and satisfaction in using learning tools for their educational development. Besides, it is also important for students to develop good attitudes towards the use of augmented reality in their research and development processes.

H5 also revealed a significant relationship between the acceptance of augmented reality and students' satisfaction. This finding is in agreement with the finding of Bursali and Yilmaz, (2019), Goktas and Gulcu, (2017) as they affirmed the acceptance and students' satisfaction of using augmented reality in learning, research and development. This means that students in Malaysian higher institutions of learning are conversant, satisfied and accept the use of augmented reality in learning new things in education. Meanwhile, this finding confirmed the importance of augmented reality in educational endeavor of students in Malaysia and beyond. Furthermore, the results

demonstrated a positive moderating effect of gender on augmented reality adoption. Based on the interaction plot, male students postulated higher satisfaction and stronger relationship in using augmented reality than their female colleagues. This means that male students often use augmented reality than the female colleagues for learning and research purposes. This finding is in line with the finding of Okazaki and Renda dos Santos (2012) whose findings concluded that men are perceived to be better learners than women in using augmented reality. In summary, the study ascertained the strength of the hypotheses that revealed the acceptance of augmented reality by students in Malaysia institutions of higher learning and also affirmed gender as a moderating variable to students' satisfaction in augmented reality usage.

6. Conclusion

This study empirically examined the moderating role of gender in the adoption of augmented reality on students' satisfaction. The findings highlighted positive relationship use of augmented reality on students' satisfaction. Moreover, the study contributes to the existing body of knowledge in online learning as it supports the use of technological devices in educational institutions. Meanwhile, this study affirmed gender to play a moderating on the use of augmented reality on student satisfaction in Malaysia higher institution. Although there is evidence from earlier studies that college students utilise augmented reality, this study's findings reinforce earlier research by showing that students are more likely to use augmented reality for learning and research. It is evident that students in Malaysia higher education are satisfied using augmented reality Therefore, this study reaffirmed the necessity for students in other higher institutions outside Malaysia to inculcate the use of augmented reality in their studies. Finally, the study revealed the need to increase and encourage the proper usage of augmented reality from the female students since this study confirmed male to have higher usage than their female counterpart.

7. Implication of the Study

Considering the importance of augmented reality to students' educational development, this study has contributed to exiting literature on augmented reality, students' satisfaction and gender influences. Meanwhile, this study further filled the gap that presently exits in educational research by ascertaining gender as a moderating variable between augmented reality and students' satisfaction in higher education. Additionally, this study has contributed to the understanding of students' satisfaction on using digital technological devices for learning and will be of utmost benefit for the student learning development. Likewise, knowledge acquired from this study would help to provide the appropriate literature for researchers' and students who are conducting research on augmented reality and student satisfaction in their respective studies. Furthermore, the study further affirmed that there was a significant relationship between augmented reality and students' satisfaction in Malaysia higher institutions.

8. Limitation of the Study

The findings of this paper should be interpreted within the span of its limitations. The purpose of this research was to examine the moderating role of gender in the adoption of augmented reality and students' satisfaction. The focus of the study was on augmented reality in terms of perceived ease of use, perceived usefulness, perceived enjoyment and attitude to use of augmented reality. Future research may be applied to other dimensions such as e-learning, interactive learning and personalized learning. Furthermore, the paper focus was only on higher education students in Malaysia, it would be most useful if the future study could investigate similar variables from students in higher education outside Malaysia.

9. Co-Author Contribution

The authors affirmed that there is no conflict of interest in this article. Author 1 carried out the field work, prepared the literature review, wrote the research methodology and carried out the

analysis of the whole article. Authors 2, 3 and 4 overlooked the writeup, interpreted the findings and presented the recommendations.

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