© Universiti Tun Hussein Onn Malaysia Publisher's Office

OJ-TP

http://publisher.uthm.edu.my/ojs/index.php/ojtp
e-ISSN : 2289-7410

Online Journal for TVET Practitioners

Students' Acceptance Level of Augmented Reality Technology Applied to Teaching Tools Chiller Simulation System

Nurul Fitrah Kamarolzaman[1], Nizamuddin Razali[1*], Muhammad Zuhairi Abdul Jalil[1], Mohd Erfy Ismail[1], Suhaizal Hashim[1], Khairul Anuar Abdul Rahman[1]

[1]Faculty of Technical and Vocational Education,
Universiti Tun Hussein Onn Malaysia, 86400 Batu Pahat, Johor, MALAYSIA

* Corresponding Author

DOI: https://doi.org/10.30880/ojtp.2023.08.03.008
Received 05 March 2023; Accepted 07 October 2023; Available online 23 November 2023

Abstract: Along with the development of technology, Augmented Reality (AR) has been used as a teaching aid to facilitate the teaching and learning process. Nevertheless, the use of AR technology in teaching and learning session in Vocational College is still at a minimal level. Therefore, this study was conducted to identify the level of students' acceptance of AR technology from the aspects of perceived usefulness, perceived ease of use and attitude. A total of 114 students who took the Diploma in Refrigeration and Air Conditioning (PPU) program at Batu Pahat Vocational College, Kluang Vocational College, Muar Vocational College and Segamat Vocational College were involved in this study. The distribution of the questionnaire for this study is using google form through the online platform. This study uses descriptive analysis method (mean and standard deviation). The reliability value for this study instrument is α = 0.890. Overall, the results of the study showed that the level of perceived usefulness, the level of perceived ease of use and the level of attitude were at a high level with a mean value (M = 4.34, M = 4.36, M = 4.25). In conclusion, the results of this study indicate that most students have a high level of acceptance of the use of AR technology in teaching and learning session. In this regard, Vocational College should strive to enhance the use of AR technology so that the teaching and learning process can be carried out more effectively.

Keywords: Students' acceptance, augmented reality, Technology Acceptance Model (TAM), perceived usefulness, perceived ease of use

1. Introduction

Over the past few decades, technological approaches to teaching and learning have led to the development of various approaches to support learning including online homework systems, simulations, games and even entire online courses where all readings, assignments and tests are done online (Cooper et al., 2014). However, such expectations become futile if students are not really interested in using them. The best teaching aids will fail if it does not stimulate students' interest or motivate them to use it. Various studies have shown that AR technology offers many advantages when used in educational settings (Cheng & Tsai, 2012). For example, AR helps students to engage in real-world exploration (Dede, 2009). By displaying virtual elements alongside real objects, AR facilitates the observation of events that cannot be observed with the naked eye (Wu et al., 2013). Therefore, it increases students' motivation and helps them acquire better investigative skills (Sotiriou & Bogner, 2011).

However, there are challenges faced even though AR technology provides many advantages in education. The most reported challenge is that AR is difficult for students to use. Usability is an important technical factor (Chiang et al., 2014), which affects the effectiveness of education. For example, without a well-designed interface, students may

**Corresponding author: nizamuddin@uthm.edu.my*

2023 UTHM Publisher. All rights reserved.
publisher.uthm.edu.my/ojs/index.php/ojtp

experience difficulties when using this technology (Muñoz-Cristóbal et al., 2015). Usability difficulties can cause a loss of time for students and may require excessive additional lecture time. A recent study by Gavish et al. (2015) reported that the group that used AR in their study required a longer average training time than the group that did not use their AR. They suggest that this result may be partly due to the innovation of AR technology.

Another issue that must be considered in an AR learning environment is the cognitive load of students (Dunleavy et al., 2009). Cheng & Tsai (2012) suggested that students may experience cognitive overload in an AR learning environment due to the amount of material and the complexity of the task. Next, other reported challenges involve application-related and technical problems. Most technical problems are experienced in location-based AR applications. Global Positioning System (GPS) errors are problems caused by AR applications that misunderstand location and direction (Chiang et al., 2014). Similarly, low sensitivity is more often experienced in location- based AR applications (Cheng & Tsai, 2012). The conclusion that can be drawn from this study is that this matter should be taken seriously by researchers who plan to use location-based AR applications. Future technological developments are expected to solve most of the current problems experienced in location-based AR applications. Furió et al. (2013) also reported that when AR technology is used with large groups, it may be costly and regular class sessions may not provide enough time to implement some AR applications.

Challenges or problems that have been faced by past researchers can be the cause of students' acceptance of the use of AR technology in education. This will conflict with the technology acceptance factor which is the perceived usefulness (PU) and perceived ease of use (PEOU). Indirectly, this will affect the attitude of students to accept the technology used. Attitude can be defined as an individual's response to objects and circumstances that generate guiding and leading impact on the situation. This means that attitude is not a behavior but a tendency that directs an individual to a certain behavior. The Technology Acceptance Model (TAM) developed by Davis (1989) to present the factors that influence individuals in accepting technology also mentions the importance of attitude. According to TAM, the attitude of forming the intention is decisive in displaying behavior.

A positive attitude towards technology is directly related to its usability. Individual attitudes in accepting new technologies vary and as a result of this variance, process integration may end in adaptation or rejection of this technology (Akca et al., 2013). Students' attitudes towards new technologies will influence their effective and productive use in the classroom. So, it cannot be disputed that identifying students' attitudes towards AR applications is important to ensure the successful integration of AR technology into the educational environment. Indirectly, it is necessary to understand the potential of students' acceptance of AR technology applied to teaching aids chiller simulation system. Therefore, the main objective of this study is to identify the level of student acceptance of AR technology in teaching aids produced using a model based on the Technology Acceptance Model (TAM) 1989. The level of student acceptance of AR technology in teaching aids are measured with three main aspects which is level of perceived usefulness, level of perceived ease of use and level of attitude.

1.1 Literature Review

A chiller unit is a cooling system used to lower the temperature of machines, industrial spaces, and process liquids by removing heat from the system and transferring it outside of the buildings. Chillers are important for temperature control in several industrial processes such as injection molding, metal plating, oil field production and food processing. This is because this chiller system is a large commercial air conditioning system. In this research, researcher referring a teaching aids of chiller simulation system that applies IoT and AR technology to help teachers during teaching and learning sessions. Figure 1 shows the teaching aids of chiller simulation system that use in this research.

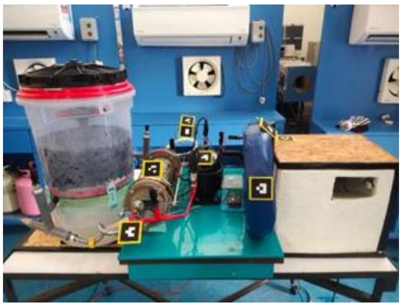

Fig. 1 - Teaching aids of chiller simulation system

There are two types of processes for the instructor uses this chiller simulation system in teaching and learning session. For the process of obtaining the performance of the product's cooling system, the system needs to be turned on and the temperature and pressure sensors will detect any changes in the system and convert it into analog data value. Arduino Wemos D1 R1 programming board that built with ESP8266 chip will process the data and get internet connection. The programming board will send to the Blynk server as interaction platform to the instructor and student after the data has been processed into digital value. Smartphones that installed Blynk software will access the Blynk server to get the data that has been stored. This setting gives the instructor the advantage of not limiting teaching activities close to the product only but interact the teaching aids using smart phone individually.

Next, the second process is to shows a three-dimensional component using the smartphone. Firstly, the researcher had prepared a unique programmed QR code to placed it on each main component. To start the process, users need to scan the QR code placed on the front of the product using a smartphone. The QR code will display a website that will require a camera to interact. Next, users can scan the QR code on each main component by using the application that has been opened. A real three-dimensional object model along with the name will be displayed and the user can look at the desired part by moving the smartphone to the left or right. This function will provide facilities to the instructor to show the actual products found in the actual chiller system. The chiller simulation system that has been developed not only applies IoT elements, but AR technology is also applied in this teaching aids. With the help of AR technology, students can see real design of the actual component when the teacher teaches using this teaching aids. The use of IoT-based applications also helps students see temperature readings easily. Figure 2 shows the AR model generated in smart phone when student or teacher hovering their smart phone around the teaching aids.

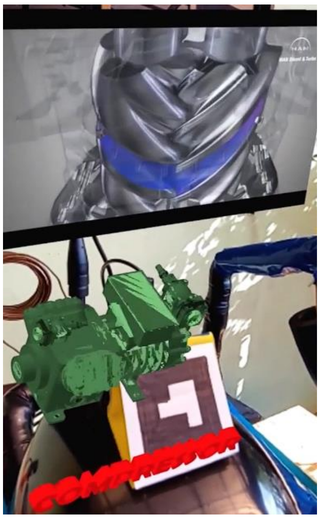

Fig. 2 - AR model generated using QR using smartphone

TAM which is a development theory from the Theory of Reasoned Action (TRA) explains why users accept or reject information technology. TRA theory is used to explain more carefully the relationship between the two main characteristics (PU and PEOU) with user attitudes, intentions and actual acceptance of technology. The two factors that are mentioned are PU and PEOU that can predict consumer behavioral intentions and technology acceptance (Venkatesh & Davis, 2000). Based on TAM, the use of information technology by a user affects behavior (BI), attitude (AT), PU and PEOU either directly or indirectly. Figure 3 shows the framework for the TAM model.

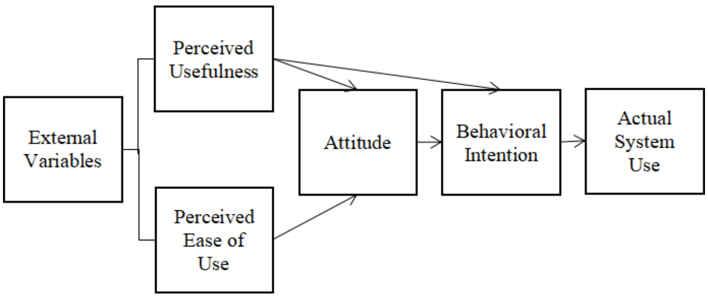

Fig. 3 - Technology Acceptance Model (TAM) (Davis, 1989)

Based on this TAM model, Davis (1989) has defined the PU as someone believing that using a system will improve performance and knowing the benefits of using information technology while the PEOU as someone feeling confident that using a system does not require any effort. These two variables are considered to be different factors that influence consumer attitudes towards technology. Therefore, the behavior to use the technology will be determined by the user's attitude towards the use of technology.

2. Methodology

In order to carry out this study, the researcher has used a descriptive quantitative survey method, which is using a questionnaire as a research instrument. Descriptive aims to gather information about variables and make a description of the phenomenon that occurs. A questionnaire will be given to respondents to conduct this study (Chua Yan Piaw, 2006)).

2.1 Population and Sample

This study is comprised of Refrigeration and Air Conditioning Diploma program students at Batu Pahat Vocational College, Kluang Vocational College, Muar Vocational College and Segamat Vocational College. The researcher chose students at 4 vocational colleges because of the constraints and lack of time to conduct research at all vocational colleges. The student population of the PPU Diploma program at these 4 vocational colleges is a total of 114 people as stated in table 1. The number of respondents in this study was determined based on the sample size table developed by Krejcie & Morgan (2016). The sampling method used in this study is probability sampling which is simple random sampling. The selected sample at least has the same characteristics as the population in the research (Konting, 2000). Therefore, for a population of 114 people, the appropriate sample size for this study is 88 respondents.

Table 1 - Population distribution and sample of PPU Diploma program students

Johor Vocational College	Total Population	Total Sample Selected
KV Batu Pahat	17	13
KV Kluang	23	17
KV Muar	51	41
KV Segamat	23	17
Total	114	88

2.2 Research Instrument

For the research instrument, researchers use questionnaire as an instrument containing 21 items which consists of three elements which is perceived usefulness, perceived ease of use and attitude. Additionally, the researcher created a validation group for the questionnaires that included lecturers who were adept in both language and technology. The questionnaire will be examined using a Likert scale (Table 2) to determine how far the study's goals have been achieved. According to Mohamed Najib (2001), instruments that use a five-point likert scale are more stable in use.

Table 2 - Likert scale (Mohamed Najib, 2001)

Rating	Scale
Strongly Disagree (SD)	1
Do Not Agree (DA)	2
Disagree (D)	3
Agreed (A)	4
Strongly Agree (SA)	5

2.3 Data Analysis

The data that has been collected will be analyzed using the Statistical Package for the Social System (SPSS) software. The type of quantitative analysis used is statistical analysis. The split statistical analysis for this study is descriptive statistics. The mean score for the level of student acceptance of technology aspects of perceived usefulness, perceived ease of use and attitude was analyzed using descriptive statistics. The researcher used the mean score to analyze the data from the questionnaire items in the form of a likert scale. Table 3 shows the interpretation of the mean range level that gives low, medium and high results.

Table 3 - Interpretation of the mean range level (Abdul Ghafar, 2013)

Mean Value	Interpretation level
3.68 - 5.00	High
2.34 - 3.67	Medium
1.00 - 2.33	Low

3. Results and Discussion

The data analysis addressed the conclusions of the data obtained from the respondents. The goal is to identify the students' acceptance level of technology towards AR in system simulation chiller. Each item also has a frequency value and a percentage value according to the respondent's response to the item. The frequency values and percentage values are arranged according to the likert scale from 'Strongly Disagree' to 'Strongly Agree'.

3.1 Level of Perceived Usefulness

Eight items are presented to answer the research question, which is what is the level of student perceived usefulness towards AR technology applied to teaching aids chiller simulation system. The overall results of the analysis of the level of perceived usefulness among vocational college students for each item are arranged according to the highest mean value to the lowest mean stated in table 5. Overall, the mean value for the level of perceived usefulness is at a high level with a mean value (M=4.34).

Table 5 - Perceived usefulness level and average mean of each item

No item	Statement		SD	DA	D	A	SA	Average mean	Level
B5	The use of AR technology can improve my performance in the chiller topic.	F %	0 0	0 0	9 10.2	22 25	57 64.8	4.55	High
B4	The use of AR technology can increase my learning motivation	F %	0 0	0 0	9 10.2	34 38.6	45 51.1	4.41	High
B2	The use of this AR technology is effective in helping me to know the phase condition of the refrigerant on each component	F %	0 0	0 0	18 20.5	19 21.6	51 58	4.38	High
B6	The use of AR technology can improve the quality of learning in chiller topics	F %	0 0	0 0	14 15.9	35 39.8	39 44.3	4.28	High
B1	The use of AR technology is useful for me to recognize the actual shape of the components used in the chiller system	F %	0 0	0 0	15 17	34 38.6	39 44.3	4.27	High
B3	The use of AR technology was effective in helping me to know the type of coolant pressure on each component	F %	0 0	0 0	19 21.6	26 29.5	43 48.9	4.27	High
B7	The use of this AR technology during the class facilitated my understanding of the chiller system concept	F %	0 0	0 0	13 14.8	38 43.2	37 42	4.27	High
B8	I can learn faster by using this AR technology	F %	0 0	0 0	14 15.9	38 43.2	36 40.9	4.25	High
						Average Mean		4.34	High

The item that found the highest mean value is item B5 which is 'The use of this AR technology can improve my performance in the chiller topic'. The findings of this study can be supported by the study Sirakaya & Cakmak (2018) who found that students from the experimental group who used AR applications were more successful in the computer hardware course. This shows that AR applications can be effective in improving student achievement. In addition, the results of the study of Mumtaz et al. (2017) showed that students who attended classes based on AR had a higher mean score compared to students who attended classes based on traditional learning. These results prove that blended learning with AR technology improves students' understanding of concepts. Next, the item that found the lowest mean value with a value of 4.25 is item B8 which is 'I can learn faster by using this AR technology'. According to the study of Keçeci et al. (2021), one of the factors of students not being able to learn quickly is due to the slow internet factor. However, the item is still at a high level despite having the lowest mean value. This shows that the majority of students agree that they can learn quickly by using AR. The findings of this study can be supported by the study of Karagozlu & Ozdamli (2017) that there are respondents who feel that when using AR applications, the topics discussed become short and simple compared to learning from books.

3.2 Level of Perceived Ease of Use

The researcher will study the level of perceived ease of use of students towards AR technology applied to teaching aids chiller simulation system to answer the second research question by submitting 7 question items. The overall results of the analysis of the level of perceived ease of use among vocational college students for each item are arranged according to the highest mean value to the lowest mean stated in table 6. Overall, the mean value for perceived ease of use is at a high level with a mean value (M=4.36).

Table 6 - Perceived ease of use level and average mean of each item

No item	Statement		SD	DA	D	A	SA	Average mean	Level
C6	The use of AR technology on this chiller simulation system is easy to understand	F	0	0	10	26	52	4.48	High
		%	0	0	11.4	29.5	59.1		
C5	I easily remember how to operate the AR technology found in the chiller simulation system	F	0	0	10	27	51	4.47	High
		%	0	0	11.4	30.7	58		
C4	This AR technology is easy to understand	F	0	0	13	30	45	4.36	High
		%	0	0	14.8	34.1	51.1		
C7	The AR technology used is easy to operate	F	0	0	14	31	43	4.33	High
		%	0	0	15.9	35.2	48.9		
C1	This AR technology does not use high effort to operate it	F	0	0	11	38	39	4.32	High
		%	0	0	12.5	43.2	44.3		
C2	I think that this AR technology is user friendly	F	0	0	14	34	40	4.3	High
		%	0	0	15.9	38.6	45.5		
C3	The image display on the application used when scanning the QR code is clearly visible	F	0	0	15	33	40	4.28	High
		%	0	0	17	37.5	45.5		
						Average Mean		4.36	High

The item that found the highest mean value is item C6 which is 'The use of AR technology on this chiller simulation system is easy to master'. The findings of this study can be supported by the study of Delello et al. (2015) who found that students took a short time to learn the AR used. This could be one of the factors students feel AR technology on the chiller simulation system is easy to learn because it is easy to use. In addition, 69% of the participants stated that they learned how to work with the application in a short period of time (Abdinejad et al., 2021). These results prove that learning using AR technology is not difficult for students to use. Next, the item that found the lowest mean value with a value of 4.28 is item C3 which is 'The image display on the application used when scanning the QR code is clearly visible'. This result may be due to a lack of suitable devices. Based on the study of Delello et al. (2015), six of the students stated that their mobile device could not read the picture to display the virtual image. One student stated that he had to borrow his friend's device to use the AR application (Delello et al., 2015). In addition, one of the factors that there are students who do not agree with this item is because the stability of marker-based AR is not satisfactory. According to the study of Cheng et al. (2017), when using marker-based AR, virtual objects always appear to wobble or flicker over time. These studies can prove that those factors cause a few students to disagree with this C3 question item.

3.3 Level of Attitude

The researcher will examine the level of students' attitudes towards AR technology applied to the teaching aids chiller simulation system to answer the third research question by presenting 6 question items. The overall results of the analysis of the level of perceived ease of use among vocational college students for each item are arranged according to the highest mean value to the lowest mean stated in table 7. Overall, the mean value for the attitude level is at a high level with a mean value (M=4.25).

Table 7 - Attitude level and average mean of each item

No item	Statement		SD	DA	D	A	SA	Average mean	Level
D1	I think that it is necessary to use AR technology in class because this technology helps to increase my motivation	F	0	0	13	31	44	4.35	High
		%	0	0	14.8	35.2	50		
D2	My interest in learning increased when using AR technology	F	0	0	13	33	42	4.33	High
		%	0	0	14.8	37.5	47.7		
D6	AR technology makes learning more interesting	F	0	0	14	34	40	4.3	High
		%	0	0	15.9	38.6	45.5		
D3	I can pay more attention to the class when AR technology is used	F	0	0	14	38	36	4.25	High
		%	0	0	15.9	43.2	40.9		
D5	I would like AR technology to be used in other air conditioning subjects	F	0	0	18	37	33	4.17	High
		%	0	0	20.5	42	37.5		
D4	I believe the use of AR technology in the classroom is a good idea	F	0	0	18	41	29	4.13	High
		%	0	0	20.5	46.6	33		
							Average Mean	4.25	High

The item that found the highest mean value is item D1 which is 'I think that it is necessary to use AR technology in class because this technology helps increase my motivation'. The findings of this study can be supported by the study of Estapa & Nadolny (2015) who found that there were some significant differences between the groups on the survey items that AR did attract students' attention to a higher level than the website-only group. These results support previous research showing that the use of AR in a classroom context by creating an environment with reality can increase student motivation (Wu et al., 2013). In addition, students who study with the proposed system show higher learning motivation and have better learning performance (Chin et al., 2018). These results prove that students agree that learning using AR technology can increase their desire to learn. Next, the item that found the lowest mean value with a value of 4.13 is item D4 which is 'I believe the use of AR technology in the classroom is a good idea'. These results show that students have a high interest in using AR in the classroom as one of the teaching and learning methods. According to Nufus (2013), teaching and learning methods that only focus on the teacher can cause students to become passive in class. This opinion is supported by Rusli et al. (2019) who stated that students are less interested and less motivated to follow the teaching and learning session in the lecture room when the teaching and learning session takes place one-way. Therefore, it is reasonable if students feel that teaching and learning methods using AR technology is a good idea because students will be more active and enthusiastic to engage in teaching and learning session.

4. Conclusion

The results of this study found that the level of perceived usefulness, the level of perceived ease of use and the level of attitude of students at Batu Pahat Vocational College, Kluang Vocational College, Muar Vocational College, and Segamat Vocational College towards the use of AR technology is high. Based on this study, it shows that the AR technology on the chiller simulation system benefits students in improving their knowledge. In addition, students expect AR technology on the chiller simulation system to be easy to use, which does not depend on their efforts. Next, students who have a positive attitude to learn a new learning environment that is using AR technology on the chiller simulation system will try to master a learning topic. The research results obtained are expected to be used as a reference for certain parties. The author suggests that the relationship between each element of the Technology Acceptance Model should be measured for future studies.

Acknowledgment

The authors fully acknowledged Universiti Tun Hussein Onn Malaysia for supporting this work.

Reference

Abdinejad, M., Talaie, B., Qorbani, H. S., & Dalili, S. (2021). Student Perceptions Using Augmented Reality and 3D

Visualization Technologies in Chemistry Education. *Journal of Science Education and Technology*, *30*(1), 87–96. https://doi.org/10.1007/S10956-020-09880-2

Akca, Y., Esen, S., & Ozer, G. (2013). The Effects of Education on Enterprise Resource Planning Implementation Success and Perceived Organizational Performance. *International Business Research*, *6*(5). https://doi.org/10.5539/IBR.V6N5P168

Cheng, J. C. P., Chen, K., & Chen, W. (2017). *Comparison of Marker-Based and Markerless AR: A Case Study of An Indoor Decoration System*. 483–490. https://doi.org/10.24928/JC3-2017/0231

Cheng, K. H., & Tsai, C. C. (2012). Affordances of Augmented Reality in Science Learning: Suggestions for Future Research. *Journal of Science Education and Technology 2012 22:4*, *22*(4), 449–462. https://doi.org/10.1007/S10956-012-9405-9

Chiang, T. H. C., Yang, S. J. H., & Hwang, G.-J. (2014). An Augmented Reality-Based Mobile Learning System to Improve Students' Learning Achievements and Motivations in Natural Science Inquiry Activities. *Educational Technology & Society*, *17*(4), 352–365.

Chin, K. Y., Wang, C. S., & Chen, Y. L. (2018). Effects of an augmented reality-based mobile system on students' learning achievements and motivation for a liberal arts course. *Https://Doi.Org/10.1080/10494820.2018.1504308*, *27*(7), 927–941. https://doi.org/10.1080/10494820.2018.1504308

Chua Yan Piaw. (2006). Mastering Research Methods. In *McGraw-Hill Education Asia; 1st edition (May 2, 2012)*. https://www.amazon.com/Mastering-Research-Methods-Chua-Piaw/dp/9675771410/ref=sr_1_4?ie=UTF8&qid=1431102965&sr=8-4&keywords=chua+yan+piaw

Cooper, M. M., Underwood, S. M., Bryfczynski, S. P., & Klymkowsky, M. W. (2014). A short history of the use of technology to model and analyze student data for teaching and research. *ACS Symposium Series*, *1166*, 219–239. https://doi.org/10.1021/BK-2014-1166.CH012

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly: Management Information Systems*, *13*(3), 319–339. https://doi.org/10.2307/249008

Dede, C. (2009). Immersive interfaces for engagement and learning. *Science (New York, N.Y.)*, *323*(5910), 66–69. https://doi.org/10.1126/SCIENCE.1167311

Delello, J. A., Mcwhorter, R. R., & Camp, K. M. (2015). Integrating Augmented Reality in Higher Education: A Multidisciplinary Study of Student Perceptions. *Journal of Educational Multimedia and Hypermedia*, *24*(3), 209–233.

Dunleavy, M., Dede, C., & Mitchell, R. (2009). Affordances and Limitations of Immersive Participatory Augmented Reality Simulations for Teaching and Learning. *Journal of Science Education and Technology 2008 18:1*, *18*(1), 7–22. https://doi.org/10.1007/S10956-008-9119-1

Estapa, A., & Nadolny, L. (2015). The Effect of an Augmented Reality Enhanced Mathematics Lesson on Student Achievement and Motivation. *Journal of STEM Education: Innovations and Research*, *16*(3), 40–48.

Furió, D., González-Gancedo, S., Juan, M. C., Seguí, I., & Rando, N. (2013). Evaluation of learning outcomes using an educational iPhone game vs. traditional game. *Computers and Education*, *64*, 1–23. https://doi.org/10.1016/J.COMPEDU.2012.12.001

Gavish, N., Gutiérrez, T., Webel, S., Rodríguez, J., Peveri, M., Bockholt, U., & Tecchia, F. (2015). Evaluating virtual reality and augmented reality training for industrial maintenance and assembly tasks. *Interactive Learning Environments*, *23*(6), 778–798. https://doi.org/10.1080/10494820.2013.815221

Karagozlu, D., & Ozdamli, F. (2017). Student opinions on mobile augmented reality application and developed content in science class. *TEM Journal*, *6*(4), 660–670. https://doi.org/10.18421/TEM64-03

Keçeci, G., Yildirim, P., & Zengin, F. K. (2021). Opinions of Secondary School Students on the Use of Mobile Augmented Reality Technology in Science Teaching. *Journal of Science Learning*, *4*(4), 327–336. https://doi.org/10.17509/jsl.v4i4.32310

Konting., M. M. (2000). *Kaedah penyelidikan pendidikan*. Dewan Bahasa dan Pustaka.

Krejcie, R. V., & Morgan, D. W. (2016). Determining Sample Size for Research Activities. *Http://Dx.Doi.Org/10.1177/001316447003000308*, *30*(3), 607–610. https://doi.org/10.1177/001316447003000308

Mumtaz, K., Iqbal, M. M., Khalid, S., Rafiq, T., Owais, S. M., & Achhab, M. Al. (2017). An E-Assessment Framework for Blended Learning with Augmented Reality to Enhance the Student Learning. *Eurasia Journal of Mathematics, Science and Technology Education*, *13*(8), 4419–4436. https://doi.org/10.12973/EURASIA.2017.00938A

Muñoz-Cristóbal, J., Prieto, L., Asensio-Pérez, J., Martínez-Monés, A., Jorrín Abellán, I. M., & Dimitriadis, Y. (2015). Coming Down to Earth: Helping Teachers Use 3D Virtual Worlds in Across-Spaces Learning Situations. *Educational Technology & Society*, *18*, 13–26.

Nufus, H. (2013). *Pengaruh Metode Resitasi Dalam Model Pembelajaran Kooperatif Tipe Two Stay Two Stray Terhadap Hasil Belajar Matematika Pada Siswa Kelas Viii Mts Darul Hikmah Pekanbaru,*.

Rusli, F. N., Zulkifli, A. N., bin Saad, M. N., & Yussop, Y. M. (2019). A study of students' motivation in using the mobile arc welding learning app. *International Journal of Interactive Mobile Technologies*, *13*(10), 89–105. https://doi.org/10.3991/IJIM.V13I10.11305

Sirakaya, M., & Cakmak, E. K. (2018). The effect of augmented reality use on achievement, misconception and course engagement. *Contemporary Educational Technology*, *9*(3), 297–314. https://doi.org/10.30935/cet.444119

Sotiriou, S., & Bogner, F. X. (2011). Visualizing the Invisible: Augmented Reality as an Innovative Science Education Scheme. *Advanced Science Letters*, *1*(1), 114–122. https://doi.org/10.1166/ASL.2008.012

Venkatesh, V., & Davis, F. D. (2000). Theoretical extension of the Technology Acceptance Model: Four longitudinal field studies. *Management Science*, *46*(2), 186–204. https://doi.org/10.1287/MNSC.46.2.186.11926

Wu, H. K., Lee, S. W. Y., Chang, H. Y., & Liang, J. C. (2013). Current status, opportunities and challenges of augmented reality in education. *Computers & Education*, *62*, 41–49. https://doi.org/10.1016/J.COMPEDU.2012.10.024