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Integration of Augmented Reality (AR) Technology in Education: Perceptions and advantages

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Abstract
Augmented Reality (AR) has become one of the 21st-century technologies to be used in education to enhance the pedagogical process. Due to its handiness and effectiveness, it may visualise abstract context into digital elements, making this mechanism one of the preferred learning trends today. Therefore, this study aims to examine the use of AR technology in Malaysian education from the insights of the educators. The significant outcome from the study has shown that educators were captivated by AR technology due to its novelty.

Keywords: Augmented Reality; Malaysian Education; Educators Perspective; Pedagogy Enhancement

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1.0 Introduction

The usage of technology in education has been considered to be a force multiplier in order to help the students to improve their cognitive ability. Furthermore, it can influence the students to participate actively in the pedagogical lesson and can motivate them, therefore leading to an efficient learning process (Saidin, Abd Halim, & Yahaya, 2015). In accordance with Shapley et al (2011), pedagogical lessons that use technology as an educational tool can teach a more innovative form of teaching and learning. In this quickly changing environment, there are a lot of innumerable sources of knowledge; thus, selecting an appropriate strategy and applying relevant information at the right time and place are vital in educational settings. Augmented Reality (AR) technology is one of the most advanced technological developments in the education sector that is tailored for 21st Century learning. Brian Mullis (2018) stated that AR technology has the capability to transfer knowledge more efficiently than any other technology that is available in this era. In addition, the appealing factor of AR as a teaching tool stems from its capacity to provide a mixed learning experience by combining virtual and actual environments or contents in the classroom (Barrow et al., 2019).

Although the world is three-dimensional, the preference to use two-dimensional media in education shows to be convenient, familiar, flexible, portable, and inexpensive (Kesim & Ozarslan, 2012). However, it is static and does not provide dynamic content. The characteristic of AR makes use of the spatial space in three-dimensional settings, whereas it creates an enhanced version of the real physical world that is achieved through the implementation of digital visual elements, sound, or any other sensory stimuli, onto the real world in real-time, to

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create a believable experience towards its users (Zambri & Kamaruzaman, 2020). In education, learning experience plays a significant role in the process of teaching and learning where it can determine the students' focus and motivation towards the learning subject. The current pedagogical process turns students into passive consumers where they only listen to the lessons without any active participation. This one-way method of teaching and learning needs to be changed to stimulate the sensory modalities such as sight, hearing, sound and touch. Past researchers believed that AR technology is a promising tool that can enhance student motivation and interest and supports the teaching and learning process in an educational context (Mat Bistaman, Syed Idrus, & Abd Rashid, 2018).

The use of AR technology in education could not be fully utilized without the educators' participation as they are the most invaluable assets in delivering the lesson content to the students and achieving the educational objective. Educators must first need to accept the AR technology as an intervention in the pedagogical process to stimulate the students' curiosity and maintain their focus on the lesson. AR is considered to be a novelty in the education segment, there have been few types of research concerning educators' perception towards AR technology. Hence, this study was designed to delve more deeply into the matter, regarding the educators' thoughts about AR technology and its effects on the teaching and learning process. Some educators believe that technology can cause learners to get addicted to it and lower their self-esteem and confidence, yet these educators overlook the benefits of technology's usefulness and usability in education (Mat Bistaman, Syed Idrus, & Abd Rashid, 2018). Therefore, it is pertinent to gain insights from the educators on the usage of AR technology in the pedagogical process and what issues might arise before any concrete implementation can be suggested.

2.0 Literature Review

2.1 Augmented Reality (AR)

The definition of Augmented Reality (AR) is straightforward. The 'Augmented' came from the word 'Augment' which means enhancing something to be better than before by adding features to it. The 'Reality' is the quality or state of being real. Therefore, combining both words to be 'Augmented Reality', means that it can enhance a personal experience or perception by adding virtual digital elements onto the real-world environment, thus significantly improving his or her ability. It presents the user with a composite vision that combines the real scene viewed by the user and computer-generated virtual scenes. This is an augmentation of the real world in which an everyday place, space, thing, or event is engaged in a partially unmediated manner. Figure 1 shows Milgram and Kishino's Mixed Reality on the Reality-Virtuality Continuum (1994) and states that AR is closer to the real-world spectrum, which should not be confused with Virtual Reality (VR) where it is much closer towards the virtual spectrum.

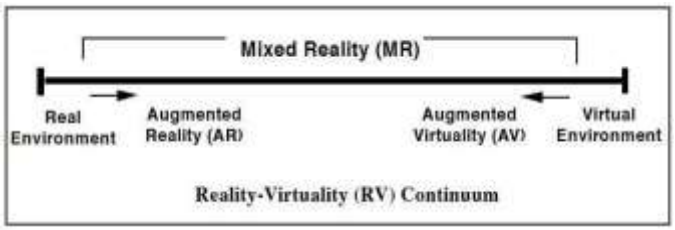

Figure 1: Milgram and Kishino's Mixed Reality on the Reality-Virtuality Continuum
(Source: https://www.frontiersin.org/articles/10.3389/frvir.2021.647997/full)

Several platforms can be used to access the AR space, such as webcams, tablets, Head-Mounted Displays (HMD), or smartphones. In the height of AR technology, the smartphone was considered to be the most suitable medium as it enables everyone to engage with the AR environment, besides the fact that it is estimated around 6.37 billion people owned a smartphone (Bankmycell, 2021). With the invention of Pokemon GO by Niantic in 2016, it popularised AR technology among the people and gave them awareness about it where it had become a phenomenon all around the world with 550 million downloads (Zambri & Kamaruzaman, 2020). As the technology gained popularity among the general population, there have been numerous studies and initiatives to incorporate AR technology into their profession, with the educational sector now being the most widely used (Azuma, 1997).

2.2 Augmented Reality (AR) in Education

The employment of technology methods is an essential aspect of attracting students' attention in the classroom. As a result, it is highly recommended that technology be employed to improve teaching and learning processes (Nasser, 2018), as well as the presentation of learning materials. Technology acts as a force multiplier for educators, allowing pupils to access websites, online tutorials, and a variety of other services in cyberspace rather than relying just on educators as a source of knowledge. The educational landscape has shifted dramatically in recent years, particularly in areas where technology is integrated with adequate pedagogical foundations (Halim et al., 2020). One such technology is the usage of AR technology.

Augmented Reality (AR) has received a lot of interest in the educational field because of numerous characteristics of the technology that may favourably influence students' learning processes ((Mat Bistaman, Syed Idrus, & Abd Rashid, 2018). This is due to the fact that it can provide an engaging learning environment as well as a brain path of least resistance for pupils to absorb abstract knowledge while maintaining their attention and curiosity (Zambri & Kamaruzaman, 2020). Another intriguing use of this technology is in augmented reality textbooks (Kessim & Ozarslan, 2012). These books are printed regularly, but pointing a webcam at them brings up visualisations and

interactivity that have been built. This can be accomplished by installing special software on a computer, utilising particular mobile apps, or visiting a website. After publishing, this technique can turn any existing book into an augmented reality version. The simplest way to connect the two isolated worlds is to use 3D objects and views, various and imaginative media, simulations with various forms of interactions. Textbooks will become dynamic sources of information by incorporating Augmented Reality onto printed book pages. People with no computer knowledge can nevertheless enjoy a tremendous interactive experience in this way.

3.0 Methodology

A qualitative semi-structured interview was conducted with four educators from three schools in Klang, Valley. The schools that were chosen are as follows: Sekolah Kebangsaan Sungai Siput, Sekolah Kebangsaan Teluk Pulai, and Sekolah Kebangsaan Telok Gadong. They were all chosen through snowball sampling as the first educator was recommended by a Pusat Pendidikan Daerah (PPD), Klang officer. The first educator was then asked to identify other potential respondents for the study. Table 1 shows detailed demographics of the educator-respondents.

Due to the Pandemic Covid-19 situation, National Security Council (MKN), Malaysia has enforced a strict procedure (SOP) to curb the level of these diseases. Hence, all respondents were interviewed using the same SOP such as interviews were conducted one-on-one in a private room. to give them a sense of confidentiality, they can freely share their thoughts and perceptions without any external intervention. All conversations were audio-recorded for transcribing purposes during the data analysis phase. As for the data analysis, the researcher had opted for thematic analysis to analyse the transcribed interview dataset.

Table 1: Educator Respondent's Demographics

	Gender	Schools	Age
Educator A	Female	SK Telok Gadong	42
Educator B	Female	SK Teluk Pulai	45
Educator C	Male	SK Sungai Siput	53
Educator D	Male	SK Telok Gadong	55

3.1 Augmented Reality (AR) Application

The study had designed an AR application to be used as a research instrument during the data collection phase. The AR app was made using Unity3D with Vuforia and 'marker-based' as the foundation. The 'marker-based' architecture (Figure 2) was fabricated from the same Augmented Reality working system model from Zambri & Kamaruzaman (2020). Before the semi-interview session, the researcher had shown the educators the AR app along with a brief introduction to what AR technology is and what it can do. Furthermore, the researcher had selected a Standard 4 History textbook as the marker. After creating the application in Unity3D, the researcher packaged it as an Android App using Vuforia AR source codes so that it could be installed and ready to use in an Android smartphone. Figure 3 shows the interface of the AR app.

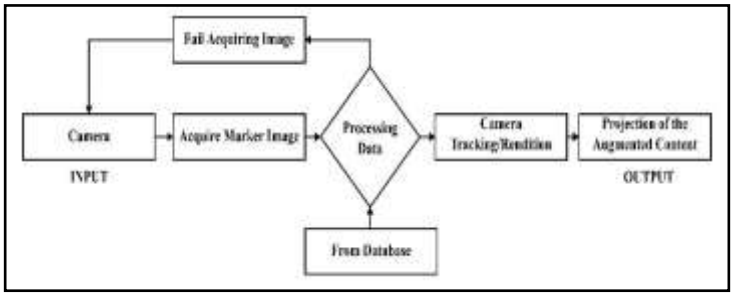

Figure 2: System Architecture of Marker-based AR
(Source: https://www.semanticscholar.org/paper/The-Integration-of-Augmented-Reality-(AR)-in-Zambri-Kamaruzaman/572800ef4597b0cd5c54c55a45396fb9b839e1fe)

Figure 3: User Interface of AR app

4.0 Results

Thematic analysis was carried out to discover the recurring themes within the dataset. Words, phrases, and common concepts were uncovered after appearing numerous times in the transcripts. Analysis shows that four themes emerged: Promotes Self-Study, Improves Cognitive, Professional Development, and Issues/Barriers.

4.1 Promotes Self-Study

Augmented Reality (AR) is a technology capable of bringing the virtual world into the actual world, improving user experiences. All educator respondents agreed that with such AR features, students will be motivated to explore the textbook and learn more.

Educator A: Students can't focus for more than 5 to 10 minutes. Students couldn't understand the context because there isn't much description, leading to the student questioning why they should learn this subject. With AR technology, children will get eager to learn even if it's from a textbook.
Educator B: AR would offer them the experience as if the graphics given to them are genuine. With AR, it is as if the learning content has come to life, and students can experience it without having to visit a museum and learn it wherever and whenever they choose.
Educator C: Students liked to study through images, which interested them in learning. Given the standard textbook, they are being forced to learn, but if we use AR technology, they will have the initiative to learn.
Educator D: Students can receive such information and understand the subject more easily with AR technology because they desire to accomplish things swiftly and effectively. As a result, students will take the initiative to learn even when not in the classroom.

4.2 Improves Cognitive

All educator-participants stated that teaching using AR would improve their students' cognitive ability. Usually, they had to think of creative ways to keep the students entertained with the lessons, either by doing a field trip to the museum or making scrapbooks. The use of AR can give a whole new meaning of learning where it helps the students to become active consumers by engaging with the lessons while the educator explains the context.

Educator A: Learning can be boring especially learning history. Why, in their opinion, should they learn about the past? It can better explain the context with this technique. Students would be overjoyed.
Educator B: Students can comprehend what we would try to teach them, thus saving us time and resources.
Educator C: Students learn through visuals and would be very interested in this technology. They can focus better and remember more context through visuals than through conventional learning.
Educator D: Students would love using this technology as it can visualise the learning context. Hence, they can understand what the lesson is trying to convey without the educators having to explain it to them many times over, losing precious time.

4.3 Professional Development

The educators stated that they have no reservations about incorporating AR technology into their pedagogical processes and would go to considerable measures, such as enrolling in workshops or classes, to learn how to use the technology appropriately. This demonstrates that instructors were concerned with their teaching quality in order to accomplish the learning goals. Furthermore, they demonstrated that they accept technology as a part of the educational process, dispelling the stereotype that educators are resistant to embracing technology and prefer traditional methods of instruction.

Educator A: Before this, we usually have a workshop for anything that is a new approach linked to IT, and if this technology has a workshop/class, this will absolutely enable educators to use it in teaching.
Educator B: I do not mind integrating or using this technology in my classroom. I am not sure about others, but I am sure they would love to use it as well, as long as there is a proper approach to these things**.**
Educator C: Of course, I'd like to learn how to use it to teach. We had practised doing online quizzes in the computer lab and Google Classroom, so this should be no different.
Educator D: This (technology) should be integrated as quickly as possible. Educators have no issues with learning new technology and applying it during teaching and learning. Typically, there are seminars on how to organise it, and participation (from educators) are always exceptional.

4.4 Issues/Barriers

Although all the educator-respondents praise the AR technology for its novelty, unique characteristics, and visualisation of abstract contents, few of them have concerns over the technology. For them, this technology can be a double-edged sword. Creating a vibrant and robust learning environment using technology as an educational tool has always been the objective of these educators. However, students may also use the technology for other purposes, thus deviating from the educational objective.
Educator A: Students are tech-savvy nowadays, and they are more knowledgeable than us. However, I am worried that they might be doing something else while we are teaching.
Educator B: I have concerns over the matter because sometimes, I encounter students not focusing on the subject at hand due to them 'exploring' the technology. Such as, when **Educator C**: I brought them to a computer lab, instead of using it for educational purposes, they were playing games.

Educator D: There is no denying that technology is fantastic, but I am concerned that if there are no limitations, pupils will want to do something other than learning if they become bored with the course.

5.0 Discussion

The study was done among the educators to gain their understanding and perspective of using AR technology in education to improve the teaching and learning environment. During the briefing on the designed AR app, all the educator-respondents were in awe of the technology due to its novelty. They were astonished by its characteristics of immersion and heightened experience. Moreover, the educator-respondents show favourable insights towards the AR technology, stating that it can change how the students learn and how the educators teach. Furthermore, it can change a dull classroom environment to a full and active learning session. Students are often bored when they are learning, and educators need to develop instructional methods to keep them interested. With the help of AR technology as an education tool, students would have the motivation not only to learn but also have the capability to understand the concept that the educator is trying to educate them. Furthermore, according to Bob Sumner (2017), we have much great content or information ready for consumption, but due to the time limit or experts having busy schedules, this knowledge is not flowing. Therefore, AR technology serves as an intervention where students can still learn even without the educator by their side. However, the invention of AR technology is not meant to replace the educators but to enhance the pedagogical process as well as ensure that students can learn anytime and anywhere. There are, however, few concerns among the educator-respondents where they are worried that students might use the AR technology for something else and not focus on the lesson itself. Nevertheless, Zambri & Kamaruzaman (2020) had stated that with proper guidelines and instructional design policies, these issues can be mitigated. Besides that, the benefits of using AR as the educator-respondents had stated outweigh the issues and barriers.

6.0 Conclusion

Augmented Reality (AR) can make the impossible possible with its characteristics of visualisation and immersion. The use of AR technology in education has been shown to have its advantages in improving the teaching and learning environment. In addition, Mullins (2018) had stated that AR is the best form of technology in knowledge transfer. Besides that, the results showed that, although there were some forms of truth in the myth of educators being afraid of technology having the opposite effects on the students' and not accepting it, however, results shows that they have a favourable insight towards the AR technology and do not entirely reject the use of it in education. By integrating proper guidelines and policies in the assimilation of AR technology in the teaching and learning environment, it can be an educational tool with tremendous potential and benefits that helps to enhance the quality of education.

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Article Contribution to Related Field of Study

This study can serve as a reference for the Ministry of Education in the integration of AR technology in the education system. Besides that, other scholars who wish to explore beyond the same field of study may use this study as state-of-the-art for their research purposes.

References

Ab Halim, F., Wan Muda, W. H. N., Zakaria, N., & Samad, N. H. (2019). The Potential of Using Augmented Reality (AR) Technology as Learning Material in TVET. Journal of Technical Education and Training, 12(1).

Azuma, R.T. (1997). A survey of augmented reality. Presence Teleoperators Virtual Environ, 6, 355–385.

Barrow, J., Forker, C., Sands, A., O'Hare, D., & Hurst, W. (2019). Augmented Reality for Enhancing Life Science Education. Paper presented at VISUAL 2019 - The Fourth International Conference on Applications and Systems of Visual Paradigms, Rome, Italy.

D. N. Nasser. (2018). "Augmented Reality in Education Learning and Training," JCCO Joint International Conference on ICT in Education and Training, International Conference on Computing in Arabic, and International Conference on Geocomputing (JCCO: TICET-ICCA-GECO), 2018, pp. 1-7, doi: 10.1109/ICCA-TICET.2018.8726192.

Kessim, M., & Ozarslan, Y. (2012). Augmented Reality in Education: Current Technologies and the Potential in Education. Procedia – Social and Behavioral Sciencess, 47(810), 297-302. DOI: 10.1016/j.sbspro.2012.06.654

Mat Bistaman, I. N., Syed Zulkarnain, S. Z., & Abd Rashid, S. (2018). The Use of Augmented Reality Technology for Primary School Education in Perlis, Malaysia. Journal of Physics: Conference Series. 1019. 012064. 10.1088/1742-6596/1019/1/012064.

Mullins, B. (2018). Redefining what is humanly possible with augmented reality. TEDxSanDiego. Retrieved from https://www.youtube.com/watch?v=x6_IZ8e9KuE&ab_channel=TEDxTalks

Saidin, N. F., Abd Halim, N. D., & Yahaya, N. (2015). A Review Research on Augmented Reality in Education: Advantages and Applications. International Education Studies, 8 (13).

Shapley, K., Sheehan, D., Maloney, C., & Caranikas-Walker, F. (2011). Effects of technology Immersion on Middle School Students' Learning Opportunities and Achievement. The Journal Educational Research, 104, 299-315. http://dx.doi.org/10.1080/00220671003767615

Sumner, B. (2017). Augmented Creativity. TedxZurich. Retrieved from https://www.youtube.com/watch?v=AJJOWemfOYI&t=2s&ab_channel=TEDxTalks

Zambri, A. A., & M. F. Kamaruzaman. (2020) "The Integration of Augmented Reality (AR) in Learning Environment," 2020 Sixth International Conference on e-Learning (econf), pp. 194-198, doi: 10.1109/econf51404.2020.9385487.