

## ***Immersive Learning by Implementing Augmented Reality: Now and The Future***

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### **Abstrak**

*Penelitian ini membahas penggunaan teknologi Augmented Reality (AR) pada pembelajaran yang imersif dilihat dari perkembangannya yang terjadi saat ini dan di masa yang akan datang. Pembahasan mengurai manfaat dari teknologi AR dari penelitian yang telah dilakukan sebelumnya dalam periode 5 tahun terakhir. Metode penelitian yang digunakan adalah qualitative, quantitative, mixed, systems design and review papers dengan mengambil sample sebanyak 125 paper yang sesuai pada tujuan penelitian ini. Dari hasil penelitian diketahui bahwa teknologi AR akan terus berkembang menjadi bagian dari kehidupan individu dan masyarakat. Begitu juga dalam konteks pendidikan teknologi AR bukan hanya akan menjadi seperangkat sumber daya, alat untuk berkomunikasi, berkolaborasi, mempresentasikan, membuat objek dan praktik untuk proses pengajaran tetapi AR akan menjadi bagian tak terpisahkan dari dunia pendidikan.*

**Kata kunci**—*Augmented Reality, Pembelajaran Imersif, Media Pembelajaran,*

### **Abstract**

*This study discusses the use of Augmented Reality (AR) technology in immersive learning seen from its current and future developments. The discussion explores the benefits of AR technology from previous research in the past 5 years. The research method used is qualitative, quantitative, mixed, systems design and review papers by taking a sample of 125 papers which are suitable for the purpose of this study. From the research results, it is known that AR technology will continue to develop into a part of individual and community life. Likewise, in the context of education, AR technology will not only become a set of resources, tools for communicating, collaborating, presenting, creating objects and practices for the teaching process, but AR will become an inseparable part of the world of education.*

**Keywords**—*Augmented Reality, Immersive Learning, Learning Media*

## **1. INTRODUCTION**

Augmented Reality (AR) has a technology which become a widely discussed research topic in recent years. The application of this technology has been carried out extensively in various fields of life, including in the teaching and learning process in education. In the literature that has been previously done, it is known that many argue that AR can be used as a tool for the learning process with a new format where there are still many opportunities for studies to be carried out for sustainable development in the future along with relevant technological developments (McCall et al, 2011)

AR is a technology that can combine virtual objects in real-time against digital content created by computers with the real world so that they appear to blend with the world around us. Augmented Reality allows users to view 2D or 3D virtual objects projected on the real world. From the point of view of the world of education that has used this technology, it is known that AR brings new opportunities to adapt different learning devices so that the learning method becomes unique so that it can embrace various types of students (Fenstermacher et al, 1984). The difference between the two objects is the existence of a real object and a virtual object. Real objects can be images or objects as AR markers, while virtual objects can be text, animations, 3D models, or videos that are combined with the actual environment so that the user feels the virtual object object in the environment (Wang et al, 2005). The combined results of the two objects can then be displayed with virtual objects appearing side by side in the same space as objects in the real world. Currently research on this technology is growing very rapidly, especially in the world of education. This research explores a lot about the effects of AR technology on its implications for the learning process. From the results of literature review and research that has been done previously specifically in this paper, the researcher will discuss the implementation of Augmented Reality with immersive learning seen from the present and in the future. This study will also discuss the advantages and challenges of AR technology, especially in the world of education to provide an overview and ideas about effective pedagogical practices for the future of education so that AR could be maximally applied. In everyday life, this AR technology has become part of the life of modern society. In the world of education AR is still seen as a set of tools, resources and practices that are used to teach, communicate, collaborate, create and present material in the learning and teaching process. The challenge of making AR an inseparable part of the world of education is still a research study at this time. However, interestingly, when technology was new, there were many opportunities for educators who wanted to develop better teaching practices, but not a few ideas for its implementation experienced obstacles to be able to use this technology effectively.

The military uses AR applications since 50 years ago. Then this technology continues to be developed for other special needs and continues to develop until now where AR is increasingly developing with the presence of cellular technology (Sommerauer et al, 2014). In addition to text, video, image and animation, AR applications are also developing towards 3D models. With the advantages it has, this application has very varied content support so that it can bring an innovative approach to the multimedia learning environment. This provides an advantage to students so that they can experience an interesting, original and motivational learning process (Richard et al, 2015).

From journals collected by researchers, many previous studies discuss the benefits of AR in education, including the following: Martin-Gutierrez et al (2015) show that AR provides benefits to education with collaborative and autonomous learning methods. According to Azuma et al (2001) AR systems are characterized by three properties: Combining real and virtual objects in a real environment. The use of different screens and technologies can result in different physical immersion rates. For example, a head-mounted or spatial display encourages a higher immersion rate working by hand, such as a PDA or smartphone (Carmigniani et al, 2010). AR is already used by students of all ages, from preschool to medical school and other informal education. There is also research that shows that adding AR in the teaching

and learning process can improve performance (Dawis et al, 1984), knowledge retention (Klopher et al, 2008), student participation and attitudes (Zhang et al, 2014), increase motivation and interest (Ferrer,2015) and also skills in observation and observation (Akçayir et al, 2016).

In an effort to improve students' perceptions and conceptual mastery of AR technology, this technology can be included in modules or practice guidelines in the learning process (Suryawinata, 2010). The use of AR also provides benefits for practicum activities in schools where this technology can facilitate students to be able to interact in a digital context so that students' imagination and creativity also increase (Hwang et al, 2016). In addition to the advantages previously described, several studies have found obstacles in the learning process using AR technology. One of them is that students become sensitive to changes in point of view and for the equipment used, a lot of memory is installed (Cheng et al, 2013).

A person who uses a digital system can be called a digital citizen. Digital literacy in general is a set of competency transfer capabilities for adequate, safe, and productive use of digital technology in the teaching and learning process. With AR in the learning process, students' sensory abilities increase. This supports the learning process that does not only hone cognitive, affective and psychomotor abilities. This technology can also be applied in games, education, industry and other fields by adding virtual objects to the real world. This application can generally be used for 2 types of the foundation were showed in table 1.

**Table 1.** AR Foundation

<b>Core of AR Application</b>	<b>AR Kit Application</b>
SDK ARCore Google untuk Unity	Plugin Unity ARKit
SDK ARCore	ARKit SDK
Perangkat Android	Perangkat iOS

Device Requirements are an Android 7.0, Galaxy S7 or later and any kind of pixel phone. For iOS, you can use the iPhone SE, iPhone 6s or later. The main applications of AR technology are tracking and reconstruction systems. Content and user interaction also plays an important role for the success of AR applications. The tracking process begins by detecting a 2D marker through a gadget or smartphone camera with the media on the module or practical guide. Then with the coordinate system on this 2D real market object, it is first registered using the Vuforia SDK and processed using the Unity game engine. These applications can be added such as 3D animation, audio, video and programming lines (Chang et al, 2014). To add a full menu and other additional features, the AR Unity app is exported to Android Studio to be saved as an APK. When the application is run, the camera on the gadget / android smartphone scans the 2D marker then sends the information to the device (Ma'ruf et al, 2017).

## 2. RESEARCH METHOD

The literature sources for this review are the Social Sciences Citation Index (SSCI) database, ACM, IEEE / IEE Electronic Library (IEL), SAGE Journals, Springer,

and Taylor & Francis. The time span is set from 2018 to April 2021. This research follows the stages according to a systematic review with five main activities as follows:

- a. Conduct analysis by asking research questions and conceptualizing.
- b. Collect relevant data and ensure that the research carried out is relevant to the objectives of this research.
- c. Evaluate research papers or journals critically and process them systematically so that they are easy to understand.
- d. Conduct a conclusive and accurate analysis.
- e. Make a final conclusion

The five stages above are described as follows:

- a. The keyword "Augmented Reality" was used for data collection, and 125 papers were identified as the research sample set from this review. Based on the research questions defined above, the researcher used the search term "augmented reality" AND "AND" theory ("learn \* OR teach \* OR educate \*") to retrieve relevant literature.
- b. The research methods involved (qualitative, quantitative, mixed, systems design and review papers) and the effectiveness of AR in the 125 papers in this study. By limiting the search to peer-reviewed scholarly articles and initially finding 125 database entries in multiple languages.
- c. Focusing on articles available in English, the database shows 101 results. After skipping duplicates and incorrect entries, such as articles that were still not in English or that were not peer-reviewed (although this is indicated in the meta data), 84 sources remained. In the next step, 84 articles were selected for the catalog. Each article is represented by an internal serial number, the article title, the subject provided by the database search tool or, if no information is provided, the article keyword. In addition, the researcher collects information about the source (that is, the journal or conference article), the year it was published, and additional information about the main topics covered by the article. In the abstract or introduction to the article, the researcher also adds information about the topic of learning, learning theory, target group, and the number of participants in the study.
- d. The following criteria were taken in this study to be sampled and showed in table 2.

**Table 2.** Data Criteria

Unused Data Criteria	Used Data Criteria
Not a scientific source	Article was peer-reviewed
Not in English language	Article was original research in English language
Not related to development of AR	Article focuses on AR development
Do not provide evaluation results	Article contains empirical result of resting AR

- e. The fifth stage is described in the result section.

### 3. RESULT AND DISCUSSION

From the results of the literature review that has been done, AR technology is known to help improve the quality of student learning experiences and student learning motivation also increases. From all the discussions that have been described above, it is known that the future benefits of AR for the world of education are as follows on table 3.

**Table 3.** AR for Now and in the Future

No	Now	Future
1	Students can be involved in carrying out authentic exploration in the real world so that they become impressed and remember the details of the learning process that occurs.	Performance can be increased as well as learning retention
2	Make it easier for students to observe virtual elements in addition to real objects where this is difficult to do with the naked eye.	Increase motivation and interest in learning in students
3	Helping students acquire skills to carry out detailed investigations.	Able to increase the positive attitude of students with the inspiration generated from this AR technology
4	Increase students' motivation in exploring knowledge or discussion topics they are studying.	Increase the pleasure in studying or learning while playing so that there is a feeling of comfort.
5	Combining digital and physical objects or what is known as immersive hybrid learning. This helps students develop skills so that they can practice critical thinking, problem solving and good communication skills.	Increase student engagement
6	Increase the perceived value of product and brands	Encourage more exploration
7	Increase engagement and interaction in user experience	Provide facilitated interaction
8	Inexpensive alternative to other media platforms as no specific media needs to be purchased.	Reducing the cost of education
9	Provides a richer user experience	Improve the learning experience
10	AR has practical applications for organizations across different industry sectors.	Provide additional information
11	Increase engagement in learning by augmenting historical and cultural locations.	Creating a student-centered environment
12	AR bring rapidly growing smartphone market	Bring more collaboration in the learning process
13	Implemented AR activity conveys innovation and responsiveness from forward-thinking	Increase innovation capacity
14	Have detailed analytics enabling them to truly understand their audience	Increase awareness and authenticity of learning

No	Now	Future
15	Augmented induction processes for new HE students in a campus environment	Provides convenience in understanding the material being studied
16	Deliver more value to advertisers by offering measurable AR print ads with direct links to purchase	Understand the material by using all the senses at work.

#### 4. CONCLUSION

From the description that has been done in this study, it can be concluded that Augmented Reality technology has effects and implications for education which is currently still in its early stages. This study also discussed the advantages and challenges of AR used in education using empirical data. AR technology will continue to develop into a part of the lives of individuals and society. Likewise, in the context of education, AR technology will not only become a set of resources, tools for communicating, collaborating, presenting, creating objects and practices for the teaching process, but AR will become an inseparable part of the world of education. In addition, with the application of immersive AR in the learning process, the position of AR in the educational context can be concluded:

- a. Helping students to engage in authentic exploration in the real world.
- b. Facilitates events that cannot be easily observed with the naked eye displaying virtual elements alongside real objects.
- c. Increase student motivation and help them acquire better skills.
- d. Create a hybrid learning environment that combines digital and physical objects, thereby facilitating skills development. For example, critical thinking, problem problems, and communication through collaborative exercises are interrelated.

#### 5. SUGGESTION

From the results of this study, further research plans will be able to be developed as follows:

- a. Creating a model that could be applied generally to all subjects at schools.
- b. Developing AR prototypes which could be utilized more widely by educators in order for this technology becomes familiar and user friendly.

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