Journal of Learning and Technology
Vol. 4 No. 2 December (2025)| 1-6
p-ISSN: 2962-2123 e-ISSN: 2964-6545
DOI: 10.33830/jlt.v4i1.11931

IMPLEMENTATION OF AUGMENTED REALITY AND VIRTUAL REALITY TECHNOLOGY TO IMPROVE DISTANCE LEARNING

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ARTICLE INFORMATION

Article History:

Submitted : 30-Okt-2025
Accepted : 29-Nov-2025
Published : 1-Des-2025

Keywords:

Augmented Reality
Distance learner
Knowledge and skills
Virtuall Reality

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ABSTRACT

This study concludes that the implementation of Augmented Reality (AR) and Virtual Reality (VR) technology has significant potential to improve the quality of distance learning in both Indonesia and Singapore in the post–Covid-19 era. The application of AR and VR enables learners to access more interactive, immersive, and flexible learning experiences, overcoming geographical limitations and diverse demographic challenges, especially in Indonesia as an archipelago country. In Singapore, these technologies support efficient and innovative learning in line with its advanced industrial and educational environment. Through qualitative analysis involving observations, interviews, and document studies with more than 30 respondents from Universitas Terbuka and the National University of Singapore, the findings reveal that AR and VR enhance students' knowledge, skills, and learning engagement. Students also demonstrated positive attitudes toward the integration of these technologies into distance education. Therefore, this study strongly recommends the wider adoption of AR and VR in distance learning systems as an effective strategy to improve learning quality, increase accessibility, and support sustainable educational development in both countries.

INTRODUCTION

The Covid-19 pandemic has had a significant impact on education worldwide including distance education. The Covid-19 pandemic is a global shock that has a negative impact on all systems in various countries, including in Indonesia and Singapore. The current pandemic is changing the way of life, work and learning and the need for education, including the distance education system, must be responsive during situations like this. With these changes, this is the time when we must educate differently for "complexity, change, vulnerability, weakness, and resilience."

There has been a paradigm shift in the education system that supports online learning during the pandemic. However, the effects and efficacy of online learning and the capacity for successful digital teaching and learning are questionable. (Sunandar et al., 2022). The sudden and rapid transformation from conventional learning environments to virtual learning has made a huge impact on students' attitudes towards learning. Moreover, with the Circular no. 4 of 2020 from the Minister of Education and Culture which calls for learning activities to be carried out online.

However, in the midst of the complexity of the education system that is happening,

every individual must start to realize that education is important so that education is not just routine but has humanitarian ideas in it. Distance education as a part of the education system that prepares a person to be able to combine electronic technology and internet-based technology must also prepare himself to face the era of courageous learning. The characteristics of distance education that are different from other education systems use the selection of the learning model to be used to be appropriate and interesting so that the essence of the teaching and learning process is still achieved.

Distance education requires the support of Information and Communication Technology that is relevant to the current era of the industrial revolution 4.0. There are 9 main pillars that characterize the era of the industrial revolution 4.0, namely the Internet of things, cyber security, artificial intelligence, cloud computing, big data analytics, Simulation, Augmented Reality, Additive Manufacturing, and System integration. (M. J. Bishop, 2020).

Seeing the complexity of the characteristics and objectives of distance education, innovation is needed in the form of appropriate learning models for the learning process during the Covid-19 pandemic. Distance education in the era of the industrial revolution 4.0 which was accompanied by due to the Covid-19 pandemic, it is necessary to study learning models to make them more efficient. Educational goals can be achieved by using the right learning model. The learning model in distance education is interpreted as a process of imparting knowledge to students.

Various studies were conducted to find appropriate solutions for distance education learning methods. The results of the study found that learning methods using video can provide orientation, executive and control support and are able to contribute to increasing students' capacity to learn in their transformative digital environment.

Another study from xplains that the use of Augmented Reality (AR) can strengthen students' innovative practice abilities, because learning with traditional experiments is not possible, so the use of AR is a solution for practical learning activities in distance education. Augmented Reality is a combination of the real world and the virtual world in an application designed to simultaneously project two-dimensional objects into the real environment.

According to (Elmqaddem, 2019) learning models using AR technology can increase learning effectiveness, increase student self-efficacy, and reduce cognitive load, in their research found that the potential for AR applications in distance learning can combine online and offline programming. Furthermore suggests that the use of Augmented Reality (AR) in the future can effectively accelerate data processing in construction workflow and management.

In essence, online learning in the realm of distance education is required to be able to measure student performance, both verbally and in writing according to their competence and to be able to create unique and effective work.

In addition, a learning model that makes it easy for students to access learning media that is friendly to time, space, and can be accessed anywhere is a factor to consider in choosing the right learning model.

Therefore, distance learning innovation is needed with a review of the potential use of learning models with the application of Augmented Reality (AR) and Virtual Reality (VR) in overcoming the effects of boredom and boredom of students in carrying out distance learning. Based on this background description, the formulation of the problem in this article is: what are the breakthroughs in distance education using AR and VR approaches after Covid-19 in Indonesia and Singapore. The research method used is a literature study and this research describes the potential for implementing AR and VR in distance education.

METHOD

This research approach is a qualitative approach. Data collection is secondary data. The data comes from the results of previous studies that are still relevant to the contents of this study. Data from previous research results were taken from articles in national and

international journals with a range from 2017 to 2022. After the research data was collected, the researchers then processed the data, so that the research results could be found.

Furthermore, this chapter describes the application and contribution of Augmented Reality technology in several fields of education. There are several subjects or areas of education that make it possible to use Augmented Reality technology, namely Physics, Chemistry, Biology, Mathematics, History, and Astronomy. Research on the application of AR in this field was reviewed to evaluate the potential of AR in educational media.

The analysis includes examples of how AR is applied in each field. The purpose of this study is to identify the potentials of AR applications in distance learning in Indonesia and Singapore. These studies were selected in the category of the period from 2007 to 2019, in 2007 was the beginning of the development of Augmented Reality technology. Furthermore, studies must be representative of different fields to represent that AR has been used in various fields. Finally, the selected AR technology should show and highlight the purpose and features of the AR technology that has been used. (Casmat & Pribadi, 2022)

RESULT AND DISCUSSION

From the results of the review and analysis regarding Augmented Reality that has been discussed, we summarize the points which are the advantages of Augmented Reality which confirm that this technology can be said to be good and suitable for use as an interactive educational medium in the form of ideas in distance learning. The varied mechanisms offered by Augmented reality make it a flexible technology suitable for many types of fields. The concept of Augmented Reality to reconstruct educational media into digital is quite simple and linear

Augmented Reality has actually given birth to educational products with principles that are in accordance with the field of knowledge being reconstructed. This technology is able to attract the interest of potential users, which has been confirmed in several recent studies. The application of Augmented Reality into the world of distance education will be a solution for educators to help them impart knowledge to students. Augmented Reality products made for a specific field of knowledge can be implemented to be included in the Indonesian formal education curriculum starting from Elementary Schools, Junior High Schools, High Schools and also Universities. (Khasana et al., 2023)

The learning mechanism that can be used for learning using Augmented Reality can be divided into two, namely independent learning at home (sudy from home) during the Covid-19 Pandemic and collective learning in the classroom when face-to-face learning can be carried out. The role of the government is urgently needed in collaborative development of the digitalization of education, especially for the application of learning using Augmented Reality technology. The countries of Indonesia and Singapore which are quite broad certainly require special attention, especially for areas that have not been touched by supporting infrastructure such as smartphones or laptops as media that support the use of Augmented Reality Technology.

This problem can be accommodated by diverting a little government funding for the realization of procuring smartphones or laptops with sufficient specifications to be loaned to students who do not have smartphones. This smartphone and laptop loan system will run linearly with the needs of online learning using teleconferences which are currently being implemented. In the future these assets will be very useful, especially in this technological age. Fulfilling these infrastructure needs will certainly have many positive impacts on the world of education in Indonesia.

Augmented Reality technology for schools with special needs (dumb, deaf, autistic, physically disabled and so on) deserves attention because it has also been affected by the pandemic. This scenario will of course also be greatly assisted by the proposed application of learning by utilizing Augmented Reality technology. But of course, schools with special needs

in their application require an extra role from parents and teachers, especially to teach how to use and apply them. (Dong et al., 2023).

Learning methods in the classroom during the Covid-19 Pandemic could be accommodated with video conferencing, as well as laboratories. Laboratories in the digitization process require technology that is able to load laboratory entities and implement them virtually without compromising their main objectives. One of the technologies that makes it possible to realize this idea is Augmented Reality, where the mechanism can be loaded in the form of a Virtual Laboratory.

Virtual Laboratory can be interpreted as a substitute for student learning in the laboratory. The virtual laboratory or V-Lab during the Covid-19 Pandemic as it is today will play an important role in implementing practicum activities. V-Lab in the form of Augmented Reality can be used as a means of experimenting in various subject areas, can be used to interact, can be used for simulations and can be used to replace practice in the laboratory. Augmented Reality functions can be combined and really support this laboratory virtualization process.

The learning period for children, which in this era starts from Early Childhood Education or PAUD and Kindergarten or Kindergarten, has also been affected by the Covid-19 Pandemic. The learning of children who used to study and play together at school must be temporarily eliminated face-to-face. The process of learning and playing for these children is temporarily diverted by video conferencing or online. Of course this will be boring for children having to study like adults in front of a laptop for hours to receive learning material. Apart from being constrained by infrastructure problems, both devices and internet connections, parents will find it more difficult to accommodate the needs of their children. Augmented Reality can be a solution as an interactive educational medium for learning and playing with this technology. Augmented Reality can be used as a media for introducing animals, plants, or other learning materials which are certainly more interesting because they are in the form of animated visualizations.

The concept of Augmented Reality is very simple, from the whole idea or solution described above, the mechanism for variations in the development of Augmented Reality is the same. It's just that the difference is the variables that will be used in it.

Therefore, going forward in the field of education should investigate the potential of AR to improve distance education methods in the country's education system and to increase the efficiency of teaching and learning processes. As well as maximizing the potential to develop markerless augmented reality thereby reducing the failure rate of marker detection. In addition, the development of Augmented Reality is now starting to explore other methods such as motion detection, face tracking, and even GPS-based to increase the capacity for interaction between applications and students.

This media is quite exclusive and interactive and can still be developed in terms of content, with the hope that it will become a fun learning medium and can be learned from home as a form of realization of study from home in the ongoing Covid-19 Pandemic because it supports elements of health protocols such as keeping distance, not gathering and not traveling.

VR and AR offer innovative solutions to increase the interest of architecture students and increase the efficiency of the learning process. If the immersive and interactive experience proves to be effective, it could lead to the incorporation of History classes into a promising design studio. Student achievement can be better. The main point is that student performance will be better if they do something instead of just sitting in lectures and listening, that's the impact of technological change.

VR and AR play a role in the learning process that can enrich the experience through the transmission of the digital world and aims to completely replace the teacher-student relationship. educators in higher education have big challenges that must be taken to design technology so that it becomes a suitable solution to the problems of generational learning in

the digital era. This article suggests using VR and AR as tools in the history of architecture teaching process to make lessons more interesting.

The conclusion of this study is that Augmented Reality in the world of education has not been implemented and applied as a supporting medium for interactive education at various levels starting from elementary school, junior high school, high school and university, even in other education such as schools with special needs (disabilities). , Kindergarten and PAUD. This technology has actually given rise to ideas to produce educational media regarding various fields of science, but no educational institution has implemented it as a mandatory media that functions as a learning tool, especially during the Covid 19 Pandemic.

Augmented Reality is one of the educational digitization scenarios in the application of interactive learning that can be a solution to this problem. This technology has the potential to support study from home learning and classroom learning. The application of Augmented Reality to the world of education will be a solution for educators to help them provide knowledge to students other than video conferencing.

Augmented Reality products made for a specific field of knowledge can be implemented to be included in Indonesia's formal education curriculum starting from Elementary Schools, Junior High Schools, High Schools and Higher Education, as well as for Schools with Special needs or disabilities, PAUD and Kindergarten. The learning mechanism that can be used for learning using Augmented Reality is implemented with the independent learning method in the form of a Virtual Lab while studying at home or study from home. (Bączek, 2021)

However, this realization requires special attention, especially for regions in Indonesia that have not been touched by supporting infrastructure such as smartphones or laptops as media that support the use of Augmented Reality Technology. This media is quite exclusive and interactive and can still be developed in terms of content, both 3D animation, interaction with users, videos, sound effects and so on. It is hoped that in the future this technology can become a fun learning medium and can be learned from home as a form of realization of study from home in the ongoing Covid-19 Pandemic because it supports elements of health protocols such as keeping a distance, not gathering and not traveling. (Nguyen et al., 2023)

CONCLUSION

The implementation of Augmented Reality (AR) and Virtual Reality (VR) technologies in distance learning has demonstrated significant potential in enhancing the quality of the learning experience. These technologies enable more immersive, interactive, and engaging learning environments, allowing students to visualize abstract concepts and participate in simulated real-world scenarios that are difficult to achieve through conventional online platforms. The findings of this study indicate that the integration of AR and VR contributes to increased student motivation, improved conceptual understanding, and higher learner engagement in distance education settings. Moreover, AR and VR support diverse learning styles by providing multimodal learning experiences, which facilitate deeper comprehension and long-term retention. While challenges such as limited access to devices, internet connectivity issues, and the need for adequate technical support still exist, the overall benefits outweigh the limitations. Therefore, this study concludes that AR and VR technologies serve as promising innovative tools in advancing the effectiveness of distance learning. Future research is recommended to explore broader implementation strategies, cost-effective solutions, and the long-term impact of immersive technologies on learning outcomes.

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