LITERATURE REVIEW: THE IMPACT OF AUGMENTED REALITY ON THE PROCESS

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Abstract: The application of Augmented Reality (AR) technology in education has been the focus of various studies due to its potential in improving the learning process. This article examines the impact of AR use on education through the Systematic Literature Review (SLR) method by analyzing 15 selected journals published in 2020-2024. The results show that AR has a significant positive impact in improving student understanding, learning motivation, as well as providing an immersive and interactive learning experience. In particular, AR helps students understand abstract concepts, strengthens memory through multisensory experiences, and improves learning effectiveness at various levels of education. However, challenges such as limited infrastructure and educator readiness remain barriers to the widespread implementation of AR. Thus, AR is a potential innovation to enrich the learning process in the digital era.

Keywords: Augmented Reality, Learning Process, Learning Motivation, Student Comprehension

INTRODUCTION

Education is one of the important aspects in a person's development. Education is a conscious guidance or leadership by educators towards the physical and spiritual development of the educated, towards the formation of the main personality. In a narrow sense, education is all planned activities with organized material, carried out on a scheduled basis in a predetermined supervisory system (Hidayat et al., 2024).

The development of technology in the digital era is progressing rapidly as time goes on. This progress is definitely related to the world of education itself. Education today is very close to technology. According to Nursdiansyah et al., 2024), in the world of education, the use of technology is mostly centered on the media used for teaching.

Highlighting 21st-century education, technology is an indispensable learning support. Some of the benefits of technology in learning as said according to (Mariyati et al., 2022) that technology has a big role in improving the quality of learning. Along with the increasing application of technology in learning, it shows the benefits of AR technology in increasing learning motivation (Afrian & Raharja, 2022).

Augmented reality (AR) technology has become an important field of research. The potential of AR in Indonesia is growing rapidly, even though it is not as massive as abroad. One definition of AR is a combination of objects contained in the virtual/virtual world that are applied in the real world with a 2-dimensional or 3-dimensional form (Aprilinda et al., 2020). Augmented reality in the world of education has not been implemented and applied as a medium to support interactive education in schools, because there are no educational institutions that apply it as a mandatory medium that functions as a learning tool (Andis Indrawan et al., 2021). Based on some of the research above it reveals that the use of augmented reality technology has an effect on the learning process. Thus, this research aims to unravel the impact of augmented reality on the learning process.

METHOD

The research method used is a Systematic Literature Review. This method is a research method that focuses on the stages, steps, or processes of identifying, assessing or analyzing, evaluating, and interpreting in making conclusions based on all selected research results and obtained in systematic and structured journals (Suciati et al., 2022). According to (Hormadia & Putra, 2021) Systematic literature review includes 3 stages, namely planning, conducting, and reporting.

Figure 1. Stages of the Systematic Literature Review (SLR) Method (2021)

Research with the Systematic Literature Review method in the planning stage. The questions relevant to the research topic are determined as follows:

Research Question (RQ) used in this study:

Research Question (RQ) 1: What journals show the positive impact of augmented reality on the learning process?

Research Question (RQ) 2: Does the journal explain the negative impact of Augmented Reality (AR) on students' concept understanding in the classroom learning process?

The second stage, namely searching for literature or identification, discusses the search for relevant journals and articles through academic databases such as Scopus, PubMed, Crossref, and Google Scholar. Based on the title of the research, "Literature Review: The Impact of Augmented Reality on the Learning Process". The identification of literature found contains descriptions of theories, articles, and research journals taken from other sources as the basis for this discussion activity.

The third stage is searching for appropriate literature, discussing about determining whether the information obtained can be used as research material or not. QA1: The selected journal was published from 2020 to 2024. QA2: The journal explains the positive impact of augmented reality in the learning process. QA3: The journal explains the negative impact of Augmented Reality (AR) on the learning process in the classroom. And the final stage is to make research conclusions, discuss the results of logical analysis, and make a brief conclusion of the discussion of the answers to the research questions.

RESULT AND DISCUSSION

Result

The QA in this study includes QA1, QA2, and QA3:

QA1: Selected journals published from 2020 to 2024

QA2: The journal explains the positive impact of augmented reality in the learning process.

QA3: The journal explains the negative impact of Augmented Reality (AR) on students' understanding of concepts in the classroom learning process.

The QA assessment is presented in table form as follows:

Table 1. QA Assessment

No.	Author and Year	*Quality Assement* (QA)			Results
		QA1	QA2	QA3	
1	Pradana,(2020)	Yes	Yes	Yes	Accepted
2	Nistrina, (2021)	Yes	Yes	Yes	Accepted

No.	Author and Year	*Quality Assement* (QA)			Results
		QA1	QA2	QA3	
3	Azzalea, (2023)	Yes	Yes	Yes	Accepted
4	Nursdiansyah et al. (2024)	Yes	Yes	Yes	Accepted
5	Dessye et al., (2024)	Yes	Yes	Yes	Accepted
6	Carolina, (2022)	Yes	Yes	Yes	Accepted
7	Restika et al., (2021)	Yes	Yes	Yes	Accepted
8	Gunawan, (2023)	Yes	Yes	Yes	Accepted
9	Cahyaningrum et al., (2022)	Yes	Yes	Yes	Accepted
10	Sugiarso, (2024)	Yes	Yes	Yes	Accepted
11	(Hadi et al., 2024)	Yes	Yes	Yes	Accepted
12	(Leliavia, 2023)	Yes	Yes	Yes	Accepted
13	(Muhammad et al., 2022)	Yes	Yes	Yes	Accepted
14	(Kuswinardi et al., 2023)	Yes	Yes	Yes	Accepted
15	(Ibisono et al., 2020)	Yes	Yes	Yes	Accepted

Based on the results of the table above, it can be clarified that there are 15 journals published in 2020-2024 related to the keyword "Impact of Augmented Reality". All journals found qualify as secondary data and are analyzed in the following table:

No.	Researcher	Title	Research Results
1.	Pradana, (2020)	Use of Augmented Reality in High Schools in Indonesia	Augmented reality in high school education in Indonesia is very diverse. Augmented reality is felt to be very capable of fulfilling the world's needs in the current era. The use of Augmented Reality is very helpful for students in achieving the success of the learning process. Augmented Reality is also very helpful to teachers in delivering their learning more effectively.
2.	Nistrina, (2021)	Application of Augmented Reality in Learning Media	The application of Augmented Reality in the world of Education will be a solution for educators to help them provide knowledge to students in addition to video conferencing. In particular, AR allows combining and superimposing real objects and virtual objects with the information to be conveyed.
3.	Azzalea, (2023)	Use of Augmented Reality (AR) Technology in Mathematics Learning: Impact on Student Understanding	Overall, the use of Augmented Reality (AR) Technology in mathematics learning has a significant positive impact on student understanding. It enhances motivation, understanding, and personalization of learning, although care needs to be taken in addressing challenges related to accessibility. With the continued development of AR technology, more interactive and effective math learning could become the norm in the future.
4.	Nursdiansyah et al. (2024)	The Impact of Augmented Reality Technology in Improving Students'	AR helps students understand abstract concepts better and increases creativity and effectiveness in learning. It also

No.	Researcher	Title	Research Results
		Understanding of Social Studies Subjects in Elementary School	helps students understand the human body and the environment, making learning more interesting and effective.
5.	Dessye et al., (2024)	Implementation of Augmented Reality Technology in Learning: Impact on Student Learning Outcomes	This study shows the implementation of Augmented Reality (AR) technology. The use of AR in learning has a significant positive impact on student learning outcomes, especially in improving material understanding, information retention, and learning motivation. The use of AR allows students to actively engage and understand abstract concepts through interactive and multisensory learning experiences. However, technical challenges and infrastructure limitations still hinder the widespread implementation of AR in higher education.
6.	Carolina, (2022)	Augmented Reality as 3D Interactive Learning Media to Increase Digital Native Students' Learning Motivation	Based on questionnaire data, the results showed that the increase in learning motivation occurred from before using AR; there were no students who had motivation. high, After using AR as a learning medium increased to 65% of students have very high motivation. In addition, students who have high motivation before using AR are only 3% to 23%. Then, for students who have very low, low, and sufficient motivation has decreased from 58%, 15% and 14% to 0% and only 3% of students have sufficient motivation.
7.	Restika et al., (2021)	Implementation of Augmented Reality as Learning Media for Total Station Component Introduction	An Augmented Reality Total Station by utilizing Augmented Reality technology has been successfully created using Unity 3D software and in accordance with the design of the application, and can be used as a new learning medium in learning the components of the Total Station tool. This Augmented Reality application only requires a smartphone for its use, so that this application can be used anywhere and anytime.
8.	Gunawan, (2023)	Application of Augmented Reality Technology For User Experience in Educational Apps	This research shows that Augmented Reality (AR) technology has the potential to enhance the user experience in educational applications. AR can enrich the learning process through interactive visualizations, practical simulations, and gamification elements, all of which contribute to increased student understanding, motivation, and engagement. Despite challenges such as cost, device availability, and user readiness, the benefits derived from using AR in education are significant and can support more effective and enjoyable learning.
9.	Cahyaningrum et al. (2022)	Implementation of Augmented Reality on	This application can model the organs of the human digestive system using Blender in three

No.	Researcher	Title	Research Results
		Media Android-based 3D Animation Learning of the Human Digestive System	dimensions and animate so that this application can display the digestive process with the animation. This three-dimensional animation replaces conventional learning media, namely organ statues that are not optimal in learning because in terms of the number of statues less interactive and. The application can be an interesting learning medium for students. Based on the questionnaire, respondents answered that this application can increase interest in learning because reading books is not monotonous. It is hoped that in this application, especially Android-based applications and Augmented Reality in further development, other features can be added.
10.	Sugiarso, (2024)	Application of Augmented Reality Technology in Presenting Learning Materials to Increase Student Interest in Learning	The application of augmented reality technology (AR) in learning has great potential to increase students' interest in learning. The interactive and immersive learning experience offered by AR can create a learning environment that is more engaging and relevant to the real world.
11.	(Hadi et al., 2024)	Improving Geometry and Social Arithmetic Learning Outcomes of Grade V Students Using Augmented Reality Media	This research made a positive contribution to the scientific literature, confirming that the use of Renjana Primary Education - Vol. 3 No. 2 May 2023 139 Augmented Reality media can be an effective learning approach to improve numeracy learning outcomes at the elementary level. elementary school. By comparing and detailing these findings with previous relevant studies, we can expand our understanding of the various impacts of using AR in mathematics learning. However, while drawing inspiration from these positive results, it is also important to consider the challenges and contextual variables in the implementation of the technology in different schools.
12.	(Leliavia, 2023)	Augmented Reality (Ar) Learning Media as an Innovation in the Era of Industrial Revolution 4.0	Based on the results and discussion, it can be concluded that technology Augmented Reality, which was originally used in mobile games with virtual reality systems, through modification and adjustment can be used as a medium to deliver messages in the form of subject matter to students in an interesting and fun way, so Augmented Reality can be the answer to improving the quality of education in the era of the industrial revolution 4.0 which is characterized by the use of technology, digital and IoT.
13.	(Muhammad et al.,	Bibliometric Analysis:	Based on the results and discussion, the

No.	Researcher	Title	Research Results
	2022)	Augmented Reality Research in Mathematics Education	conclusion is that the country of Indonesia and The United States (based on country bibliography pairs), Journal of Physics Conference Series (based on journal bibliography pairs), publication Ibáñez (2018) (based on publication bibliography pairs), and Salinas, patricia (UK) (based on author bibliography pairs) became the most influential in the field of Augmented Reality in Mathematics Education. STEM learning and geometry materials are keywords that often appear in this field. Research on STEM has not directly involved other variables such as learning motivation, achievement, and spatial ability. Then, research on virtual reality has not directly involved other variables such as interactive, technology, and mathematics education.
14.	(Kuswinardi et al., 2023)	Effectiveness of Augmented Reality (AR) Application Utilization in Learning in Senior High School: A Systematic Review	Response to AR elements shows that this 1. Technology can make learning more interesting and interactive. 2. Improved Understanding of Material: AR helps students to understand subject matter better. 3D visualizations and other digital elements provide real context that supports a deeper understanding of course concepts. 3. Learning Customization: AR's ability to tailor learning content to students' individual levels of understanding provides a more personalized solution in education. Teachers can more effectively help students with special needs or different levels of learning.
15.	(Ibisono et al., 2020)	Effectiveness of Augmented Reality-Based Pocket Book on Material Planetary Motion to Improve Learning Achievement of Senior High School Students	Research that aims to analyze the effectiveness of an Augmented Reality-based pocket book on planetary motion material to improve the learning achievement of high school students is declared effective. Based on the results of research using pretest and posttest methods analyzed using N-gain, the N-gain score of 0.63 with the moderate category. SIGN UP.

Discussion

RQ1: What journals show the positive impact of augmented reality on the learning process?

Most studies support the use of augmented reality in the learning process. According to Nistrina, 2021) augmented reality as a learning medium can enhance the learning experience based on two theoretical frameworks that work together. In addition, the learning process with augmented reality provides a more immersive experience for students and makes them more interested in carrying out learning.

An educator must be willing to improve their competence, especially in the learning process. One of the technologies that can be used is augmented reality in the form of learning media and entertainment for students. So that it can have a positive impact on the learning process (Leliavia,

2023).

Furthermore, in terms of information retention, AR technology also has a significant impact. Students who learn with the help of AR tend to have strong memories because AR provides a strong and memorable visual experience. In contrast to conventional learning methods, AR also provides multisensory learning experiences such as visual, auditory, and kinesthetic (Dessye et al., 2024).

The use of Augmented Reality technology in learning has produced a significant impact on student understanding in the classroom. In an era where technology is increasingly dominating everyday life, AR has opened new doors in education, allowing students to experience and understand learning concepts in an interactive and immersive way (Azzalea, 2023).

The concept of student understanding itself is the ability of students to understand and master the lessons taught by educators. This understanding does not only mean knowing, but also involves the ability to understand, remember, and use information obtained during the learning process. By using AR, students are helped in understanding a lesson in class (Nursdiansyah et al., 2024).

According to (Carolina (2022), increased learning motivation also occurred after using augmented reality learning media by 65%. Based on these results, it can be concluded that AR as an interactive learning medium is effective in increasing student motivation and becomes an alternative solution that can be used to overcome the problem of low learning motivation.

RQ2: Does the journal explain the negative impact of Augmented Reality (AR) on the learning process?

Besides having a positive impact, the use of AR also hurts the learning process. According to Jaballudin & Khalid (2024) shows that excessive use of AR can reduce students' ability to solve problems and think creatively.

Although AR offers innovations in teaching methods, there are also concerns about the negative impact of excessive use of devices, such as gadget dependency and potential distraction for students (Syamsudin & Chusna, 2022). In addition, the challenge in using AR requires a high cost in its implementation.

According to (Kholifah et al., 2023) shows that although AR learning media can improve science literacy, there are limitations in accessibility and infrastructure readiness in some educational institutions that can hinder the effective application of technology.

CONCLUSION

Based on the research results, it can be concluded that augmented reality has a positive impact on the learning process. From the 15 articles analyzed, the positive impact of augmented reality can improve students' understanding, learning motivation, provide a fun learning experience, and help their memory become stronger. Overall, AR is an innovative tool to enrich the learning process, helping students learn in a more fun, interactive, and effective way, so its potential is huge to support education in the digital era.

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