https://journal.ypidathu.or.id/index.php/jete/
P - ISSN: 3025-0668
E - ISSN: 3025-0676

The Impact of Applying Augmented Reality Technology in Learning on Student Learning Experiences

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ABSTRACT

Background. Augmented Reality AR technology is a technology that combines information from the real world with computer technology, so that the learning process can provide varied learning experiences to students.

Purpose. This research was conducted with the aim of understanding the impact of applying Augmented Reality technology in learning on students' learning experiences. Apart from that, to be able to find out the impact of applying Augmented Reality technology to make learning more interesting for students, the use of Augmented Reality can help teachers and parents learn.

Method. The method used in this research is a quantitative method.This method is a way of collecting numerical data that can be tested. Data was collected through distributing questionnaires addressed to students. Furthermore, the data that has been collected from the results of distributing the questionnaire will be accessible in Excel format which can then be processed using SPSS.

Results. From this research, researchers were able to obtain research results on the impact of applying Augmented Reality technology in learning, showing that using Augmented Reality technology as a learning medium greatly facilitates learning and has the ability to change the way students think. In addition, by using Augmented Reality Technology in Learning, teachers can facilitate the exchange of information between recipients and senders or educators and students.

Conclusion. Based on the results of this research, it can be concluded that the impact of applying Augmented Reality Technology in Learning on Student Learning Experiences has a number of quite large benefits, such as providing an immersive learning experience, an interesting learning environment, and an easier learning process. Apart from that, the application of Augmented Reality Technology can also make learning more fun, increase students' interest and desire to learn, and increase students' interest in learning.

KEYWORDS

Applying Augmented, Augmented Reality, Learning Experience

Citation: Meriyati, Meriyati., Nitin, M., Brafords, S & Wiliyanti, V. (2024). The Impact of Applying Augmented Reality Technology in Learning on Student Learning Experiences. *Journal Emerging Technologies in Education*, *2*(2), 215–228. https://doi.org/10.70177/jete.v2i2.1067

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Received: June 18, 2024

Accepted: June 29, 2024

Published: June 29, 2024

INTRODUCTION

Advances in the field of information and communication technology (ICT), not only e-learning and the use of various online platforms available today have

improved the quality of education, but also several types of platforms that can help the teaching and learning process(Oubibi et al., 2022). The online platforms available include ubiquitous learning (ulearning), augmented reality (AR), virtual reality (VR), mobile learning (m-learning), gamification, games, and learning.analytics (Di Renzo et al., 2023). Mobile devices are also being used more frequently in schools, especially for children with different educational needs or with disabilities(Kemp et al., 2023). In particular, augmented reality allows combining and layering data between real and virtual objects

Basically, learning is the process of managing and organizing the environment around students to foster and encourage them to continue learning(Xing et al., 2023). Learning can also be defined as the process of providing assistance or guidance to students in carrying out the learning process. With so many students having problems, the role of the teacher as a guide is different(Jannat et al., 2023). Many differences occur in learning, such as students who are better at understanding lessons than others. These two differences allow teachers to create different learning approaches for each student(Brandonisio et al., 2024). The purpose of these differences is to provide understanding to students, so that students can change their behavior.

The existence of educational interactions or interactions that are aware of goals can be characterized as a learning process. This interaction is rooted in the teacher and the students' pedagogical learning activities(Wang et al., 2023). The planning, implementation and evaluation stages complete the learning process. Learning occurs in certain stages and does not happen instantly. Educators help students learn well(Rosmiati et al., 2023). Interaction will produce effective learning as expected. Often, current learning patterns are transmissive, where students passively absorb the knowledge structure provided by the teacher or written in textbooks. With technological developments, it can also help teaching staff prepare more varied learning materials(Chen et al., 2023).

One important component in learning planning is creating learning experiences that are appropriate to the learning objectives. Learning experience is the process of learning activities carried out by students to achieve learning goals(González-Gascon, 2022). Permendikbud (2013) stipulates that a good and correct learning process consists of at least five elements such as learning experiences, observations, questions, gathering information/experiments, processing information/relationships, and communication(Ram, 2022). What needs to be considered in creating a learning experience for a teacher is that first, the learning experience must be in accordance with the objectives and competencies to be achieved, secondly it must be in accordance with the type of materials or material, thirdly there must be adequate learning resources for students, and fourthly it must be appropriate. with student characteristics(Rozario et al., 2022).

The definition of Augmented Reality (AR) is an information technology that can combine two-dimensional or three-dimensional virtual objects into a real environment and then project or display these virtual objects in real time.(B. Li et al., 2022). In this case, not only the sense of sight can receive information, but also the senses of touch, smell, hearing, and others. This could create a promising approach to support education through Augmented Reality(Goebert et al., 2022). Augmented reality (AR) technology can help improve learning because it supports various representations, actions and student engagement. However, the role of an educator cannot be replaced in guiding students(Sunardi et al., 2022).

In the field of education, the use of augmented reality has the advantage of being an educational medium that has a significant impact. The impact of applying Augmented Reality technology shows that it will be easier for students to understand learning material(Okay & Arowoiya, 2022). Augmented Reality can also help teachers because it allows augmented reality

teaching aids to reconstruct real objects that cannot be seen directly(Bermejo & Hui, 2022). In addition, the application of Augmented Reality (AR) technology can produce amazing digital experiences that cannot be obtained with conventional learning media(Lin et al., 2022).

Augmented Reality (AR) technology makes learning more interactive and interesting. The impact of applying Augmented Reality technology allows students to understand material more quickly, increases their motivation to learn, and provides a more interactive learning experience, using interactive games and interesting visualizations("Augmented Reality Learning in Mathematics Education," 2022). Augmented Reality technology also allows students to see 2D and 3D objects more clearly, and broadens their understanding of an object being observed(Genay et al., 2022). When Augmented Reality (AR) technology is used in learning, the student learning experience is very different from the use of other Augmented Reality (AR) technologies(M. Li et al., 2022).

The type of method used in this research is a quantitative method. This method is used so that the final results of the data processing can be known clearly and precisely.Based on the explanation from the research above, researchers think that the impact of applying Augmented Reality Technology in Learning can indeed have a very big influence on students' learning experiences. With the application of Augmented Reality technology, it can encourage students to understand the maximum use of technology. And researchers also haveAIt is hoped that future researchers will research the impact of applying Augmented Reality Technology in Learning on Student Learning Experiences in more depth and develop research to get maximum results.

RESEARCH METHOD

Research design

The method that has been used in this research is the quantitative method, where to obtain research data carried out by the researcher, the researcher distributed an online questionnaire via the Google From application. From the results of the data obtained, it will later be combined and made into one. Furthermore, the data will of course be processed using the SPSS application to compare the results of the respondents' responses. By processing the data results using the SPSS application, researchers can see and compare the data that researchers have submitted regardingImpact Application of Augmented Reality Technology in Learning on Student Learning Experiences.

Research procedure

In this research, there are several stages or procedures that researchers have established. When the researcher wants to collect research data, the researcher first creates a questionnaire which is distributed online, so that the researcher can select samples randomly. The questionnaire contains 10 questions each related toImpactApplication of Augmented Reality Technology in Learning on Student Learning Experiences.The aim of the researcher in investigating this research is so that the researcher can collect, analyze and provide an understanding of the data that has been collected. That way, it will be easier for researchers to test the data being researched regardingImpactApplication of Augmented Reality Technology in Learning on Student Learning Experiences.

Research subject

In researchingImpactApplying Augmented Reality Technology in Learning to Student Learning Experiences, researchers of course determine the subject for their research. In this research, the subject of this research is aimed at students from various educational institutions. Before distributing the questionnaire by the researcher, the researcher asked the respondents first to be willing to spend their time filling out the questionnaire that the researcher would distribute. The

questionnaire each contains 10 questions aboutimpact of game-based learning integration on student motivation and engagement.

Research Ethics

In writing an article entitledThe Impact of Dependence on Gadgets on Students' Learning Concentration and Academic Performance,It is very important for researchers to consider ethical or ethical values in carrying out research. Researchers really maintain a balance in conducting research so that they remain consistent and careful in carrying out the research being researched. In this research, the researcher also upholds a commitment he has made, by presenting accurate data related to his research. Apart from that, researchers also try as much as possible to avoid negative things such as plagiarism in their research.

Data Collection and Analysis Techniques

The data collection technique carried out by the researcher aims to identify relationships and become a benchmark for the research study object material. In this research, researchers carried out data collection techniques using quantitative methods and using software in the form of a T-test. For this reason, researchers need to present data in the form of tables or diagrams which will be converted into averages or percentages. Furthermore, the researcher also did not forget to ensure that the results of the answers given by the respondents were very accurate and reliable by carrying out further testing first. Therefore, researchers must be very careful in collecting processed data.

Table 1

CategoryImpact of Dependence on Gadgets

No	Earning Category	Level of education	Percentage (%)
1	Strongly agree	Student	>90%
2	Agree	Student	25-60%
3	Disagree	Student	10-30%
4	Don't agree	Student	5-10%

Figure 1

Methods of Data Collection and Data Analysis

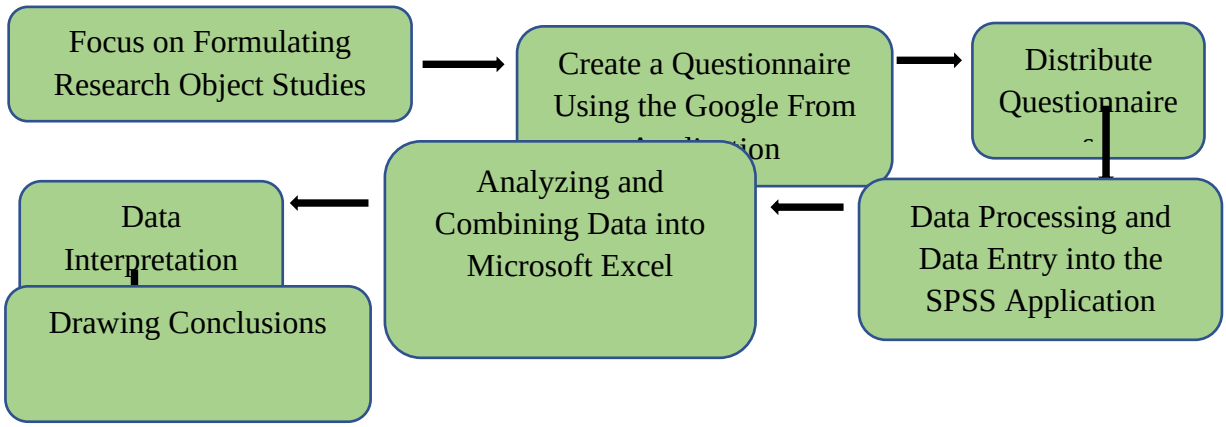

Figure 1The above shows how researchers collect and analyze research data. The results of data acquisition came from respondents' answers to the researcher's questions. Furthermore, in the quantitative research method, the researcher will also test again using the T-test which will be used to enter research data into the SPPS application. The number of questions asked by the researcher was 20 questions, where each question was divided into ten questions with different questions. Only

after the questionnaire is distributed can researchers formulate and draw conclusions from the research object.

RESULTS

The Impact of Applying Augmented Reality Technology in Learning

The use of Augmented Reality (AR) in learning has shown positive results and proven that AR can be used well in the world of education, especially as a learning medium. This application has succeeded in helping students get to know organs according to the questionnaire that has been given. The use of augmented reality (AR) as a learning medium can encourage students to think critically about problems and increase their understanding of abstract concepts. AR can also visualize abstract concepts for the structure and understanding of object models, which makes it a more suitable medium for learning purposes. AR technology can help develop learning media. The ARalatmusik.apk file built with unity is installed to install AR applications on android smartphones. The test results show that the size of the marker affects the minimum and maximum distance of the camera to track object calls.

Table 2

Summary of Percentage Results from Respondents' Answers

No.	Question	Strongly agree	Agree	Disagree	Don't agree
1	The application of AR in learning can increase students' motivation to learn.	50%	30%	12%	8%
2	AR can help students understand abstract concepts better.	60%	40%	0%	0%
3	Using AR as a learning medium can stimulate students' mindsets in thinking critically about a problem.	44%	30%	20%	6%
4	AR can visualize abstract concepts for understanding and structure of an object model	45%	45%	5%	5%
5	The application of AR in learning can improve students' abilities in critical thinking and analysis	65%	22%	8%	5%
6	AR can help students understand material more effectively.	35%	65%	0%	0%
7	The use of AR in learning can increase student participation in the learning process.	25%	60%	15%	0%
8	AR can help students understand material more interactively.	38%	55%	0%	7%
9	The application of AR in learning can improve students' ability to communicate.	45%	30%	20%	5%
10	AR can help students understand material more effectively and efficiently.	44%	45%	8%	3%

Table 2 above shows the distribution of questionnaires that have been carried out by researchers. This questionnaire contains ten questions about the impact of applying augmented reality technology in learning on students' learning experiences. In addition, during the distribution of the questionnaire, the researcher presented a percentage of each response from the respondents. Therefore, respondents can choose to answer the researcher's questions by providing options such as strongly agree, agree, disagree, or disagree. And it can also be seen from the first question asked by researchers regarding the application of AR in learning which can increase students' motivation to learn, getting the highest score of 30% with the agree option.

The second question is aboutAR can help students understand abstract concepts better, getting a percentage result of 0% disagreeing. The third question regarding the use of AR as a learning medium can stimulate students' thinking patterns in thinking critically about a problem, getting a score of 30% agree. The fourth question about AR being able to visualize abstract concepts for understanding and structure of an object model, obtained a percentage of 45% agree. Next, the fifth question, the application of AR in learning can improve students' abilities in critical thinking and analysis, there were 65% of the strongly agree option. Furthermore, the sixth regarding AR can help students understand the material more effectively, as many as 0% disagree.

The seventh question is thatThe use of AR in learning can increase student participation in the learning process, getting a percentage result of 60% choosing the agree option. In the eighth question regarding AR can help students understand the material more interactively, there was also an agree option of 55%. The ninth question regarding the application of AR in learning can improve students' ability to communicate, obtained a percentage result of 30% who agreed. For the last question regarding AR can help students understand the material more effectively and efficiently, getting a percentage gain of 44% in the strongly agree option.

Table 3

Summary of Percentage Results from Respondents' Answers

No.	Question	Strongly agree	Agree	Disagree	Don't agree
1	The use of AR in learning can improve students' ability to think creatively.	36%	59%	0%	5 %
2	AR can help students understand material more interactively and dynamically	40%	50%	10%	0%
3	The application of AR in learning can improve students' ability to think logically.	80%	20%	0%	0%
4	The application of AR in learning can increase students' motivation to learn by making the material more interactive and interesting.	52%	45%	3%	1%
5	AR can visualize abstract concepts for understanding and structure of an object model, so students can understand the material better.	70%	22%	3%	5%
6	The use of AR in learning can increase student participation in the learning process	35%	55%	8%	2%

	by making students more active in the learning process.				
7	The application of AR in learning can improve students' ability to communicate by asking students to share ideas and thoughts with friends.	66%	24%	5%	5%
8	AR can help students understand material more effectively and efficiently through the use of more sophisticated AR technology.	45%	39%	15%	0%
9	AR can help students understand material more effectively through the use of gamification and reward systems.	68%	22%	3%	7%
10	The use of AR in learning can improve students' ability to think creatively by asking students to think more creatively about the material being studied.	60%	20%	10%	10%

In the statement in table 3 above, the researcher has also created ten questions. Which can be seen from the first question regarding the use of AR in learning can improve students' ability to think creatively, getting a percentage result of 59% of agree options. Next, question number two about AR can help students understand the material more interactively and dynamically, getting the same percentage score for the agree option of 50%. The third question: The application of AR in learning can improve students' ability to think logically, getting a percentage score of 80% strongly agree.

The fourth question is aboutThe application of AR in learning can increase students' motivation to learn by making the material more interactive and interesting, getting as much as 45% of the percentage score for the agree option. The fifth question about AR can visualize abstract concepts for understanding and structure of an object model, so that students can understand the material better, getting as many as 70% of strongly agree options. The sixth question regarding the use of AR in learning can increase student participation in the learning process by making students more active in the learning process and also obtained the same percentage gain of 55% for the agree option.

Next the seventh hitsThe application of AR in learning can improve students' ability to communicate by asking students to share ideas with friends, getting a percentage score of 66% strongly agree. The eighth question about AR can help students understand material more effectively and efficiently through the use of more sophisticated AR technology, getting a percentage gain of 45% strongly agree. In question number nine, AR can help students understand the material more effectively through the use of gamification and reward systems, which was also found in the most strongly agreed option with 68%. The last question about the use of AR in learning can improve students' ability to think creatively by asking students to think more creatively about the material being studied, getting as much as 60% of the strongly agree option.

Diagram 1

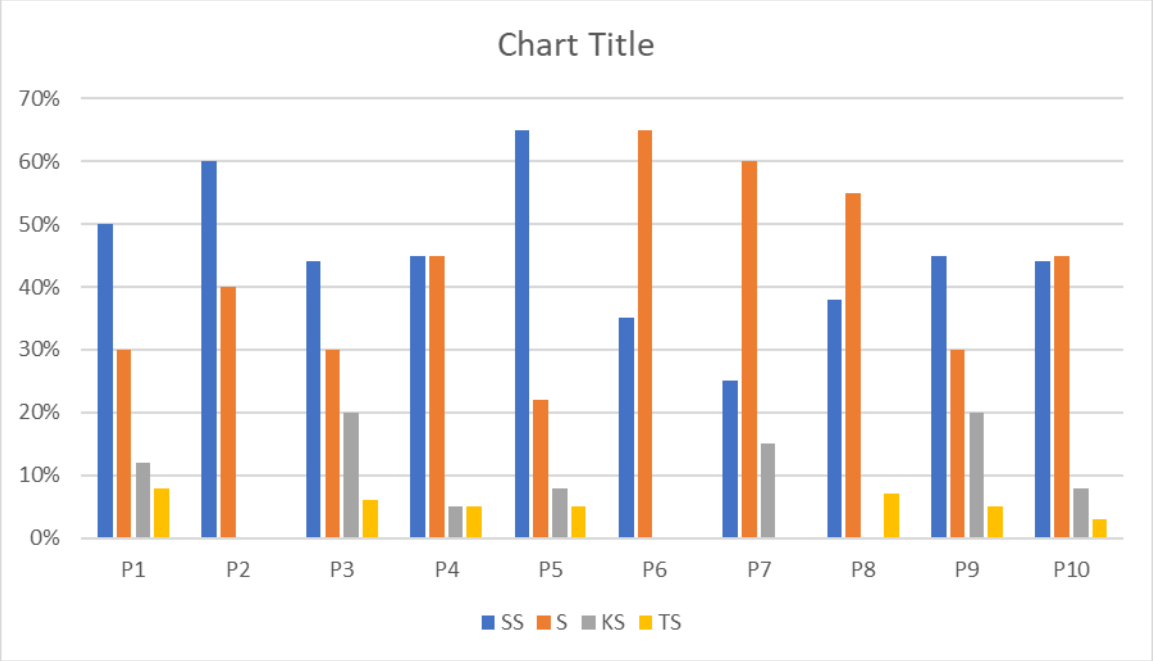

Diagram 2

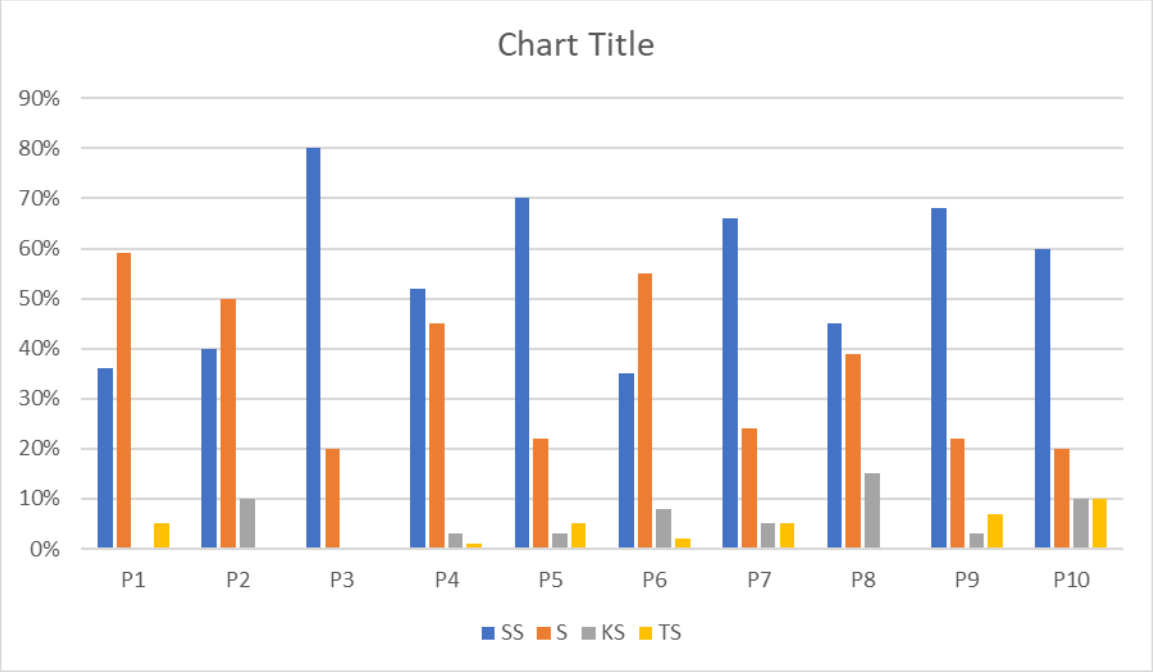

Table 3

T-test ConcerningThe Impact of Applying Augmented Reality Technology in Learning on Student Learning Experiences.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	PRE TEST	50,1500	20	14.45601	3.23246
	POST TEST	38,9000	20	15.07141	3.37007

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	PRE TEST & POST TEST	20	-.865	,000

Paired Samples Test

		Paired Differences				
					95% Confidence Interval of th Difference	
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper
Pair 1	PRE TEST - POST TEST	11.25000	28.51754	6.37672	-2.09662	24.59662

Based on the results of table 3 above, it is a T-test using the SPSS application. From the research results, the researcher can conclude that the T-test in the first output section explains the mean as the average. In the Pre Test the average number produced was 50,1500,while in the Post Test section the result was 38,9000. Based on these results, it can be formulated that there are differences in the results of the respondents' answers. Next, in the Paired Samples Correlations section, you get a correlation of -865, and the sign size is 000. Next, in the Paired Samples Test section, you get a result of 28.51754 in the Std section. Deviation, while in the Std. Error Mean obtained a result of 6.37672. Based on these results,the impact of applying augmented reality technology in learning on student learning experiences

Table 4

T-test ConcerningThe Impact of Applying Augmented Reality Technology in Learning on Student Learning Experiences

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	PRE TEST	7,2500	20	6.53634	1.46157
	POST TEST	3,7000	20	3.14726	.70375

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	PRE TEST & POST TEST	20	.124	,602

Paired Samples Test

		Paired Differences				
					95% Confidence Interval of th Difference	
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper
Pair 1	PRE TEST - POST TEST	3.55000	6.89374	1.54149	.32363	6.77637

Furthermore, in table 4, there are also the results of research using the T-test. It can be seen in the first output section that the Pre Test results were 7.2500, and the Post Test results were 3.7000. In the Paired Samples Correlations section, we obtained a Correlation of 124, with a Sign result of 602. Meanwhile, in the Paired Samples Test section, we obtained a result of 6.89374 in the Std section. Diviation, and Std. The mean error is 1.54149. Based on the results of this research, it can be seen between each question asked by researchers regarding the impact of applying augmented reality technology in learning on students' learning experiences.

DISCUSSION

Technology is a system created by humans to simplify and produce a higher level of efficiency and effectiveness in various aspects of life(Min, 2019). In a broader sense, technology can be defined as the entire means that then provides the goods necessary for human survival and comfort(Paździor et al., 2019). Various types of technology have emerged in various fields, such as information technology (IT) which allows people to convey information quickly and precisely to each other, communication technology which allows people to use certain devices to communicate, medical technology which is related to the world of medicine, where various computer technologies used in medical activities, educational technologies that allow people to use various computer technologies for teaching(Scherer et al., 2019).

OnIn everyday life, technology has offered many benefits, such as the ease of getting local and international information(Hawlitschek et al., 2018). Apart from that, technology has also had an impact on various fields, such as banking, education and health(Du et al., 2021). However, technological progress can also have negative effects, such as the use of inappropriate technology can disrupt environmental balance(Du & Li, 2019). In recent years, technology has developed very rapidly, resulting in a disproportionate increase(Mekki et al., 2019). It makes information spread very quickly throughout the world. Computers, one of the most important inventions, have led to many applications that allow humans to discover and disseminate data more quickly.

An interactive experience that combines the real world with computer-generated 3D content is called Augmented Reality (AR)(Soto-Martin et al., 2020). It is an extension of the physical world where virtual objects are connected to the real world, enhancing the user's experience with reality(Well et al., 2022). AR can be defined by three main features: combination of real and virtual worlds, real-time interaction, and accurate 3D registration of virtual and real objects(Kovaceva et al., 2020). Because they have cameras, motion sensors, and computing capabilities, smartphones and tablets have become popular platforms for implementing AR. AR has many benefits(Zheng et al., 2020). It can be used for education, communication, medical, and entertainment. It can be used to enhance natural situations or environments, offering a perceptually enriched experience.

The technology known as Augmented Reality (AR) combines virtual objects with the real world to enhance the way users perceive reality(Davila Delgado et al., 2020). Can be used for

various senses, such as touch, smell and sight. AR has been used in many fields, such as education, health, and entertainment(Tchamyou et al., 2019). In education, AR can make learning more interactive and engaging, and in healthcare, it can be used to visualize medical data in real-time, helping doctors navigate procedures more accurately(Ardoin et al., 2020). Some types of augmented reality (AR) include marker-based augmented reality, markerless augmented reality, location-based augmented reality, and projection-based augmented reality(Thomas et al., 2020). Marker-based AR uses visual landmarks to detect and track objects, while location-based augmented reality uses methods such as GPS and compass to track the user's location. Location-based augmented reality uses the user's location to provide relevant information, and augmented reality is project-based.

Student learning experiences are a collection of events and processes experienced by everyone, especially students in a particular context(Gomez et al., 2020). Student learning experiences can be mental learning experiences, affective learning experiences, or psychomotor learning experiences(McRoy et al., 2020). This mental learning experience is a learning activity designed and implemented by the teacher which is related to thinking, expressing feelings, taking initiative. Student learning experiences are a series of events, and student learning experiences can also come from the family, school or community environment.(Jensen et al., 2020). A good environment will provide a good learning experience for children, while a bad environment will provide a bad learning experience for children(Hill & West, 2020). Students' learning experiences in learning activities are very important to determine their level of achievement.

Augmented Reality (AR) technology in education is becoming increasingly popular as an innovation that has the potential to enhance students' learning experiences(Maqableh & Alia, 2021). This technology may change the way students learn by creating immersive and interactive learning environments that merge the digital and physical worlds(Glauser et al., 2019). The world of education in Indonesia has not used AR much, but it has been proven to produce good learning outcomes for students. has the ability to enhance students' learning experience by providing a more interesting and interactive way of learning(Lee et al., 2020). However, there are several problems and obstacles with the application of AR in the educational field, such as that it can increase student motivation and engagement, improve learning outcomes, and provide a more interactive and immersive learning environment.

CONCLUSION

In the educational field, the use of augmented reality (AR) has several challenges and limitations. One of them is that adequate infrastructure and technical support is needed, as well as instructions given to teachers on the use of AR technology. Additionally, there are concerns about the negative impacts or distractions that using AR in the classroom may cause. In short, the use of AR technology in education has the potential to change the way students learn and create a more interactive and engaging learning environment. However, it is important to overcome the obstacles and barriers associated with its implementation and ensure that it is used in a way that supports and enhances the student learning experience.

The use of Augmented Reality (AR) technology in learning has been proven to improve student learning experiences. Several studies have found that the use of AR applications in learning has improved student learning outcomes, especially in mathematics and physics subjects that require visualization of three-dimensional objects and data. This interaction allows students to interact with virtual objects that seem to be integrated with the real world, allowing the interaction

to be successful. Apart from that, augmented reality (AR) can also help teachers by adding props in the form of AR to reconstruct real objects that cannot be seen by naked people.

ARallows visualization of objects that are difficult to see, such as human organs and other objects. Therefore, AR can be a solution to the problem of learning media that cannot maximize learning. In several studies, AR has also been shown to improve students' ability to remember, understand, apply, and analyze abstract concepts. Data analysis shows that the application of augmented reality-based learning media in learning wave concept physics produces a good response. Thus, the use of augmented reality (AR) technology as a learning medium has the potential to improve student learning outcomes, increase student interest in lessons, and help teachers in the teaching process. Therefore, the use of AR as a learning medium can be considered an innovation that can improve the quality of education.

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