



AUGMENTED REALITY-BASED LEARNING MEDIA IN INCREASING STUDENT KNOWLEDGE

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Abstract: This research aimed to find out how to apply augmented reality learning media in increasing students' knowledge at SDN 007. This research used mixed methods, namely qualitative and quantitative methods with a type of classroom action research carried out in 2 cycles with the stages of planning, implementation, observation and reflection. The research results were obtained through collecting observation data to find out the application of augmented reality-based learning media which was tested using a percentage formula and tests used to increase students' knowledge which were tested using a percentage formula. The research results obtained after applying augmented reality were that in the pre-cycle the score was 60.1%, in the 1st cycle 80.5%, and in the 2nd cycle 90%. These scores showed that after students used augmented reality learning media, students' knowledge experienced a significant increase at State Elementary School 007 Kotabaru Reteh. The benefit of applying augmented reality learning media in schools is that it can visualize abstract learning material into concrete.

INTRODUCTION

Facing the rapid development of science and technology today, improving the quality of education is a necessity to be in line with the excellence of human resources in the field of education. Efforts that can be taken in this context involve the use of advanced technology in the learning process, both in the school environment and independently (Anantyartha & Mardiana, 2020). One concrete step is to take advantage of advanced technology, such as the use of Android smartphones, which are effective tools in supporting learning activities. Android smartphones not only provide sophisticated hardware, but also support various innovative applications (Jailani, 2021).

However, an interesting fact was clearly visible in the researcher's observation process at State Elementary School 007 Kotabaru Reteh, Indragiri Hilir Regency, Riau Province regarding the gap between the alternatives that can be used currently and the learning conditions of students there. It was proven that the level of student knowledge, which only reached 35.5%, was included in the low category, especially in relation to factual science material. Such as the motion system, the earth and the universe, the movement of the earth and moon, as well

as energy matter and its changes. Based on the problems that have been identified, a solution is needed to fix these problems, namely by implementing augmented reality-based learning media to increase students' knowledge at SDN 007 Kotabaru Reteh, Keritang District, Indragiri Hilir Regency, Riau Province.

Including augmented reality which is able to visualize objects that are difficult to access in the learning process. Augmented reality is useful as a technology that combines the real world with the virtual world. Borman (in Riskiono, Susanto, & Kristianto, 2020) said augmented reality is today's technology that can show the real world through virtual world technology. Augmented reality aims to provide better learning performance and provide opportunities for students to be involved in learning activities (Fitriyah & Wardani, 2022). This media can also provide new things that are different and useful for students in learning independently when carrying out learning activities (Setyawan, Rufi'i, & Fatirul, 2019).

Several studies have proven that augmented reality can increase the knowledge of students in elementary schools, namely Fauziah, Nafiah, Hartatik, & Sunanto, (2022) explained that the use of augmented reality can increase students' interest in learning and knowledge. Apart from that, the use of augmented reality can also shape creative traits and emotional intelligence to be measurable, as well as making students have competitive and collaborative abilities towards their peers. The results of this research became the basis for researchers to use augmented reality as a learning medium. Research results from Nistrina (2021) said that augmented reality could be a solution for educators in increasing students' knowledge. The results of this research are in line with the research results Larasati & Widyasari (2021) that the use of augmented reality media can develop students' understanding. This statement was a support for researchers to apply augmented reality media in schools.

Based on several previous studies above, it was concluded that augmented reality has been proven to be able to increase students' knowledge, interest in learning, creativity, emotional intelligence, and competitive and collaborative abilities in elementary schools. These findings provide a strong basis for this research to adopt augmented reality as a learning medium. The context of differences with recent research, this research adds further understanding or deepens the understanding of the implementation of augmented reality in the elementary school environment.

From the description above, the researcher concludes that applying augmented reality as a learning medium can bring changes to the learning climate, thereby potentially increasing students' abilities. Augmented reality is suitable for use as a medium for conveying information that can make an object look real, provide a positive message to students, and have an impact on improving the quality of education along with the development of science.

Basically, a number of previous studies consistently show that the use of augmented reality is effective in increasing students' knowledge, interest in learning, creativity, emotional intelligence, and competitive and collaborative

abilities at the elementary school level. These findings provide a convincing basis for this research to adopt augmented reality as a learning medium.

However, it was necessary to update that the latest research findings, as explained in this study, showed a discrepancy between the facts in the field and previous findings. In this context, this research adds a dimension of understanding and deepens insight regarding the implementation of augmented reality in the elementary school environment. Identification of problems at State Elementary School 007 Kotabaru Reteh, Indragiri Hilir Regency, Riau Province, showed that the level of student knowledge is relatively low, especially in factual science material. This raised the need to further investigate factors that may influence the effectiveness of augmented reality as a learning tool in elementary schools.

If this problem continues, the impact will be felt on elementary school students' knowledge regarding their ability to investigate the natural environment and solve problems that have become stagnant. Apart from that, this condition will also have implications for elementary school students' low understanding and knowledge of science concepts which have relevance in everyday life. Another problem identified is the minimal use of science learning media in elementary schools. This is a significant factor that causes students' low understanding of science material, because the science learning approach is still abstract. This problem is contrary to the characteristics of elementary school age children (7-12 years) who tend to think based on concrete experiences, because they are not yet able to imagine abstract things.

This research is important to carry out because the application of augmented reality in learning at SDN 007 Kotabaru Reteh can provide concrete solutions to the problems that have been identified. Augmented reality learning media, especially through the Assemblr Edu application, is considered an easily accessible option and can help convey abstract science learning material more concretely. Therefore, this research aimed to deepen understanding of the effectiveness of applying augmented reality learning media in increasing students' knowledge.

Augmented reality-based learning media in this research was designed using the Assemblr Edu application which has many features to support design that is appropriate to science learning materials in elementary schools. The Assemblr Edu application is one of the applications chosen for designing augmented reality because the application is easy to use. access by students and teachers via Playstore or Google Play, so that this does not become a hassle in implementing learning media in elementary schools. By applying augmented reality learning media, abstract material messages can become concrete in science learning at SDN 007.

The aim of this research was to find out how augmented reality learning media is applied in increasing students' knowledge at State Elementary School 007 Kotabaru Reteh District. Keritang, Kab. Indragiri Hilir, Riau Province, however, the aim of this research will be difficult to realize considering that teachers are not yet familiar with augmented reality learning media. Therefore, the application of

augmented reality learning media in increasing students' knowledge in elementary schools is very important to implement in order to increase teachers' insight into the benefits of sophisticated technology in the form of augmented reality learning media which can visualize learning material that is difficult to realize, with the existence of augmented learning media. The reality was that the quality of learning and students' knowledge in studying material at elementary school level will be easy to improve.

RESEARCH METHOD

The research method used is a mixed method, namely qualitative and quantitative methods. Qualitative is used to describe the stages of classroom action research (planning, implementation, observation, observation and reflection) using observations and field notes to observe the application of augmented reality-based learning media. Meanwhile, quantitative was used to measure the increase in student knowledge by using measuring instruments in the form of knowledge test questions. The indicator of success in this research was that if the student's score has reached classical completeness of 75% then the research can be said to be successful.

This type of research was classroom action research which has been implemented at SDN 007 Kotabaru Reteh, Kec. Keritang, Indragiri Hilir District, Riau Province in science subjects with material on motion systems, the earth and the universe, the movement of the earth and moon as well as energy and its changes, which was carried out from January 3 to April 5 2023. This research used subjects, namely 6 teachers and 180 students at SDN 007 Kotabaru, while the object of this research is the application of augmented reality-based learning media which is used to explicitly increase student knowledge in order to develop student achievement. Researchers collected data using various methods, namely by using observation sheets to observe teacher activities and student activities in implementing augmented reality learning media. The statement indicators on the observation sheet can be seen in table 1.

Table 1. Augmented Reality Observation Indicators

No	Indicators
1.	Augmented reality learning media refers to KI and KD
2	Augmented reality learning media can visualize material such as motion systems, the earth and the universe, the movement of the earth and moon as well as energy material and its changes in science learning in elementary schools
3	Augmented reality learning media can attract the attention of elementary school students
4	Augmented reality learning media can grow explicit knowledge for elementary school students
5	Augmented reality learning media can make it easier for students to learn independently
6	Augmented reality learning media can be accessed and used by students and teachers easily

The test used aims to measure students' knowledge after using augmented reality. The test question grid in table 2 above.

Table 2. Grid of learning outcomes test questions

No	Question Indicator	Questions	Question Type	Question No
1	Describe the function of bones	The human movement system is composed of a skeleton which is a means of movement..	Essay	1
2	Identify bone types based on shape	The spine is included in the type of bone.....	Essay	2
3.	Describe the structures that make up bones	A part of a bone that has a cavity inside is called a bone....	Essay	3
4	Mention the types of joints	The joints found in the jaw are...	Essay	4
5	Name the types of connections between bones	The connections between bones in the skull are called joints....	Essay	5

The analytical techniques used to analyze observation results and test results are:

$$P = \frac{F}{N} \times 100\%$$

Information

P= percentage of gain

F= frequency of results obtained

N= total number

The percentage formula will be applied in analyzing observation sheets and analyzing students' knowledge tests after applying augmented reality learning media.

RESULT AND DISCUSSION

Implementation of the Application of Augmented Reality Learning Media

The results of this research included data obtained from field notes and interviews with teachers and students after conducting research for 3 months at State Elementary School 007 Kotabaru Reteh. In the pre-cycle, learning was carried out conventionally using the lecture method and pictures on the classroom walls. In cycle one, educators apply augmented reality technology by distributing barcodes, then students are asked to scan the barcode to activate the augmented reality motion system in turn. However, there were still obstacles in using the application, so that some students seem confused when applying augmented reality.

After cycle one is completed, learning continues in cycle two with the same method. In this cycle, students have adapted to augmented reality technology, demonstrating the ability to learn independently with the help of augmented reality. According to (Kaminska, Zwolinski, Lesniewicz, & Raposo, 2023) The application of augmented reality-based learning media in elementary schools has great potential to improve students' learning experiences. In the context of rapid

changes in the educational landscape driven by advances in digital technology, augmented reality is emerging as an innovative solution that can address the challenges of distance learning accelerated by the COVID-19 pandemic. Although barriers remain regarding availability, accessibility, and technical skills, this research shows that projects involving augmented reality as a learning tool have provided positive evidence of student engagement and learning outcomes. This emphasizes the relevance and potential of augmented reality in increasing students' motivation and understanding of concepts in various fields of study.

As the portability, usability and user experience of augmented reality continue to improve, its applications can make a positive contribution to achieving better learning outcomes, ensuring students' readiness to face an ever-evolving digital society. Apart from that, students seemed enthusiastic about the learning process because the use of augmented reality attracted their attention. An overview of the implementation of student learning activities using augmented reality learning media can be seen in Figure 1.

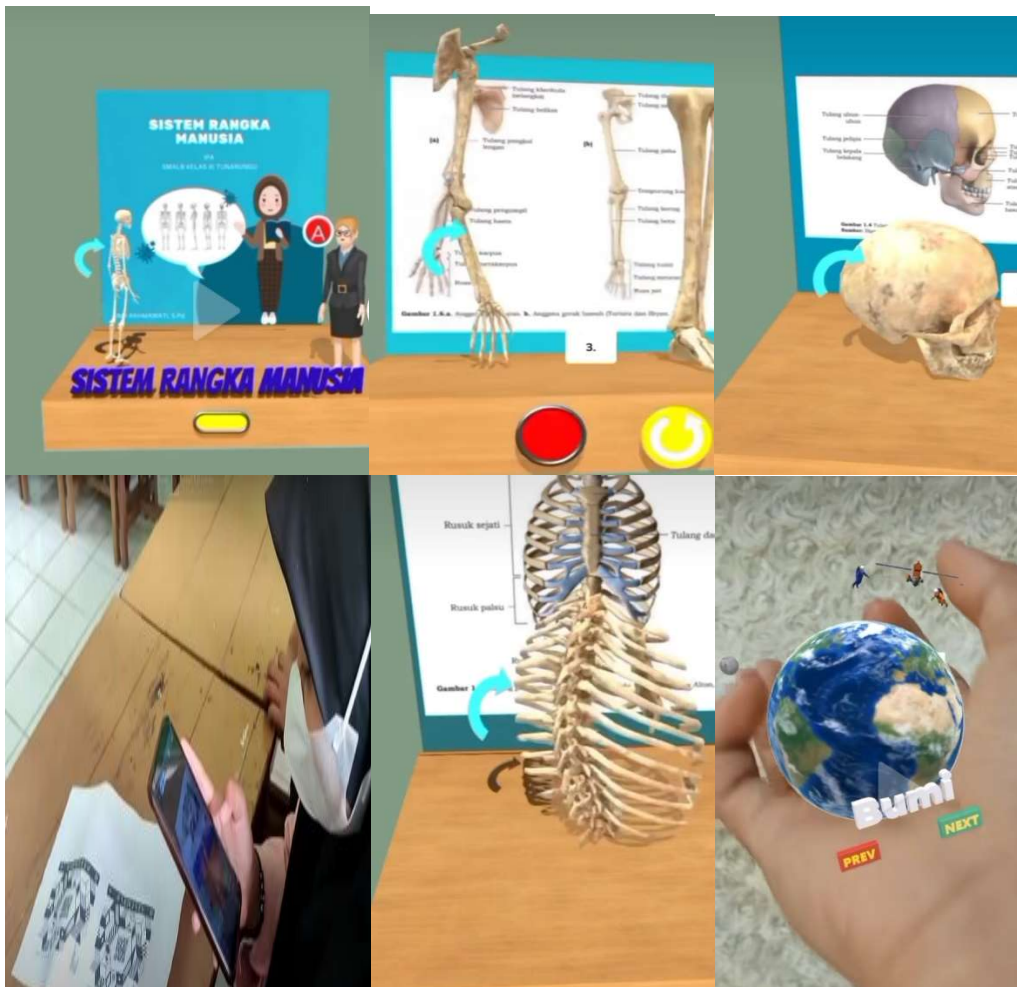


Figure 1. Student activities when using augmented reality

Figure 1 is material for the skeletal system and solar system which has been designed in the form of augmented reality in the Assamblr Edu application. Then this material is used as a learning medium to improve elementary school students'

understanding and, the picture also shows students using Assamblr Edu to learn the materials that have been designed.

Observation Results of Teachers on the Application of Augmented Reality Learning Media

The results of observations of the implementation of learning by applying augmented reality were obtained through teacher and student observations starting from before the cycle, cycle one and cycle two which are depicted in diagram 2.

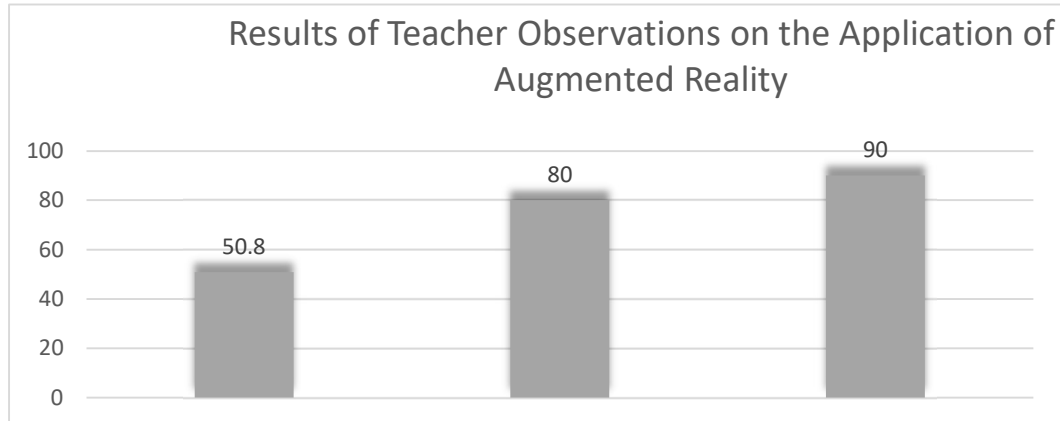


Figure 2. Comparison of Teacher Observation Results in Implementing Augmented Reality (Before Cycle, Cycle 1 & Cycle 2)

Based on the results of observations of teachers in implementing augmented reality, it can be seen that the results from the pre-cycle were 50.8%. This illustrates that in the implementation of learning before the cycle, the media used by educators was only conventional media. However, the media is inadequate for delivering material so the teacher only explains and writes on the blackboard. This was difficult for students to concrete because learning is still very abstract.

Furthermore, from pre-cycle to cycle 1, results were seen to increase by 80%. These results show that there is an increase but it is not too significant. The increase was only 29.2%, which illustrates the increase that occurred from the pre-cycle adaptation process by a teacher in using new media, namely augmented reality. However, observation results have shown results that fall within good criteria.

Furthermore, in cycle two there was an increase of 90%. This means that from cycle 1 to cycle 2 it is 10%. The improvements that occur are included in the very good criteria. These results illustrated that a teacher has been able to use augmented reality very well which can be seen in the teacher's observation results which have experienced a higher increase compared to the pre-cycle to cycle 1 scores. The description of the improvement from the results of these observations was the teacher's habit in using augmented reality. This was relevant to research conducted by Sari, et al. (2020) that augmented reality is useful for teachers in improving learning competence.

From the description above, it can be concluded that the learning carried out at SDN 007 requires teachers to have competence in order to provide varied learning so that what students get is meaningful learning. In line with research Mustaqim (2018) that the use of augmented reality technology can make things easier for users by bringing virtual information messages into the world of students so that learning will become meaningful if supported by the right media to convey information. Supported by Gogahu and Prasetyo in (Oktaviyanti, Amanatullah, Nurhasanah, & Novitasari, 2022) which said that the means of conveying learning information are things that were usually used by teachers in conveying information to convey the attention, interests and ideas of the information giver to the recipient of the message in achieving learning goals during the learning process.

Observation Results of Students on the Application of Augmented Reality Learning Media

A comparison of the results of observations on students can be seen in the following diagram.

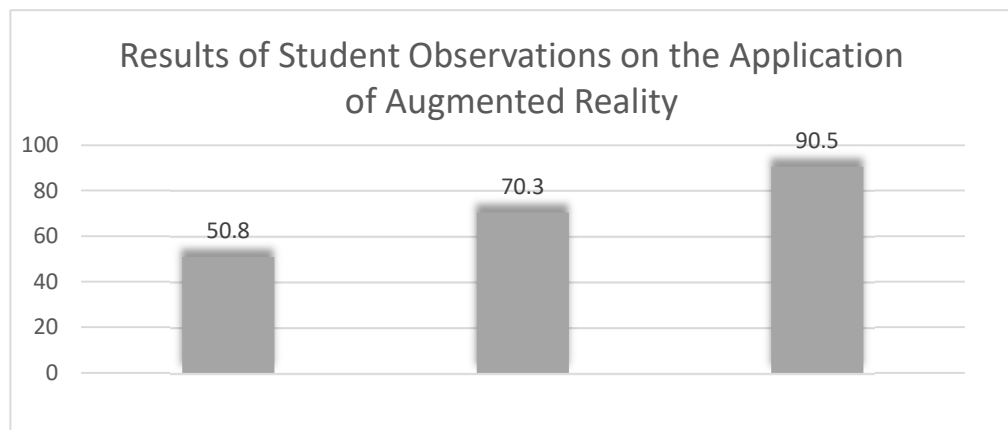


Figure 2. Comparison of Student Observation Results in Applying Augmented Reality (Before Cycle, Cycle 1 & Cycle 2)

Based on the results of teacher observations in implementing augmented reality, it can be seen that the results from the pre-cycle were 50.8%. This illustrated that in the pre-cycle the learning activities applied by educators were only conventional media. Other alternative media were inadequate for delivering material so the teacher only explains and writes on the blackboard and this is difficult for students to concrete because learning is still very abstract.

Furthermore, from pre-cycle to cycle 1, results were seen to increase by 70.3%. These results showed that there is an increase but it is not too significant, namely 19.5%. This increase illustrated that the increase that occurred from pre-cycle to the implementation of augmented reality was a shift in the learning atmosphere of students. Previously, didn't use media, but after doing research, applying augmented reality can provide something interesting for students. However, this was still a form of adaptation for students from before using media

then using augmented reality so that the visible improvements are not too significant.

Furthermore, in cycle 2 there was another increase, namely 90.5%, meaning the increase from cycle 1 to cycle 2 was 20.2%. The improvements that occurred are included in the very good criteria. These gains illustrate that students have been able to adapt to the new learning atmosphere which can be seen by the number of improvements that occur which is higher than the increase from pre-cycle to cycle 1. This is in line with (Rokhim & Rusydiyah, 2021) who said that students in the 4.0 era easily respond and adapt to all changes in learning situations.

The conclusion from the description above was that students are more enthusiastic in learning by using learning media such as augmented reality media. This statement is in line with research Dadi, Susanto, & Kristianto (2020) who said that the application of augmented reality can increase students' interest in learning. The use of learning media in teaching and learning process activities can stimulate students' interest in learning, then can increase motivation and provide enthusiasm for learning in the learning process. This had a positive psychological impact on students. This statement is in line with opinion (Wulandari, Anastasia, Cahyani, Shofiah, & Ulfiah, 2023). Choosing the right lesson can help students understand the learning material presented by the teacher. Learning media can provide concrete experiences and also act as intermediaries that help student learning. Likewise, augmented reality had the advantage of being able to be widely used in various media such as smartphones or other print media (Riskiono, Susanto, & Kristianto, 2020).

Student Knowledge Test Results After Implementing Augmented Reality Learning Media

The research results from students' knowledge tests after applying augmented reality learning media showed an increase in students' knowledge which is depicted in the following diagram.

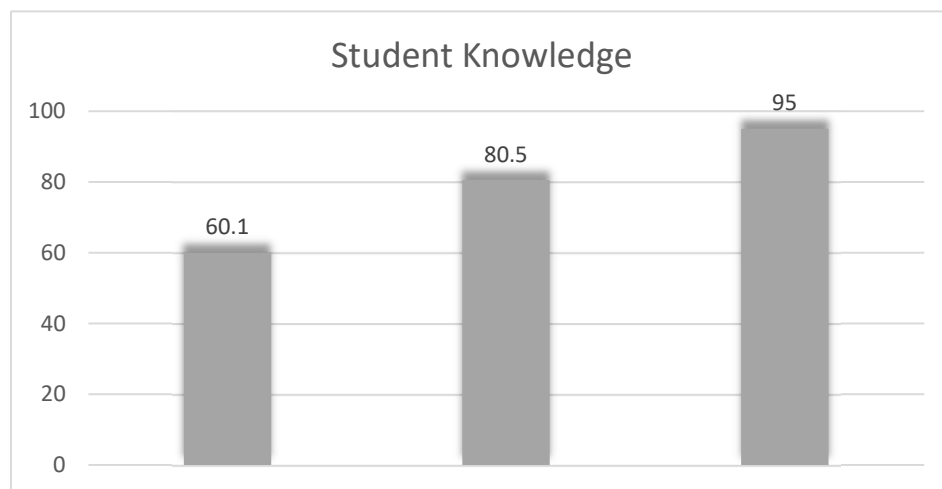


Figure 3. Comparison of Knowledge Test Results (Pre Cycle, Cycle, Cycle 1 and Cycle 2)

From the diagram of the student knowledge test results that have been presented, it can be seen that in the pre-cycle they only got a score of 60.1%. This illustrates that using conventional learning media has not been able to provide an effective increase in student learning outcomes in class 4 of SDN 007 Kotabaru.

Furthermore, in cycle 1 there was an increase of 80.5%. This shows that there was an increase from pre-cycle to cycle 1 of 20.4%. Based on these results, it illustrates that students' knowledge experienced a change from low to high values before entering the cycle stage to cycle 1 with significant values. These results show that the use of augmented reality has a positive influence on students' knowledge after using augmented reality. Mustaqim (2018) said that the use of augmented reality can provide a stimulus to students' thinking patterns so that they can increase their knowledge and critical thinking skills in solving problems that occur around them. The use of sophisticated technology in learning will make it easier for students to improve their understanding of the material they are studying (Fachri, Wahid, Baharun, & Lailiyah, 2020).

Then in cycle two, there was another increase of 95%. This matter illustrates that there was a very significant increase in returns from cycle 1 to cycle 2 of 14.5%. These results are the researcher's indicator of the success of this research, because student learning outcomes have reached 95%. These results can illustrate that the application of augmented reality greatly influences the quality of learning, especially on the knowledge of students at state elementary school 007 Kotabaru Reteh. Mustaqim (2018) explained that augmented reality can give students the opportunity to learn anytime and anywhere, which means there are no limits for students if they want to learn. It can be concluded from this statement that it provides an illustration that using augmented reality can make it easier for students to carry out learning activities independently.

In line with research Qorimah & Utama (2022) who explained that augmented reality plays an important role in providing space for imagination for students so they can improve their learning outcomes through the aspects of remembering, understanding, analyzing and applying. By using augmented reality students can be motivated in learning so that they can improve their grades higher than learning with abstract concepts. This is because learning activities are only taught directly without using augmented reality. The results of the research can provide an illustration that using augmented reality can increase the knowledge of class 1V students at state elementary school 007 Kotabaru Reteh. The improvement that occurs continuously is due to improvements in the results of reflections that have been carried out by teachers and researchers so that this supports the increased results from cycle one and cycle two. Harini (2022) said that augmented reality can improve student learning outcomes without eliminating other factors that can influence students' conditions in learning activities. According to Mustaqim (2018) the benefits of augmented reality can improve the learning process because augmented reality contains elements of entertainment so that students' interest increases. Furthermore, the benefits of augmented reality can involve all the five senses so that it can grow students' skills and creativity and will make learning meaningful.

CONCLUSION

The conclusion of this research showed that there is a significant increase in students' knowledge after implementing augmented reality learning media at SDN 007 Kotabaru Reteh. Teacher observations showed an increase from pre-cycle (50.8%) to cycle 2 (90%), while student observations also show an increase from 50.8% in pre-cycle to 90.5% in cycle 2. Improvement was not only limited to knowledge, but also includes students' critical thinking skills, attitudes, and skills. The results of the knowledge test showed an increase in scores from 60.1% in the pre-cycle to 95% in cycle 2. The implication of this research was that augmented reality learning media can positively influence student learning activities, especially in presenting abstract material visually. Although this research focused on science material, further development in other subjects is recommended. The recommendation to the school was to explore more deeply the potential of creative and relevant learning media with modern technology to improve the quality of education in the school.

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