THE EFFECT OF AUGMENTED REALITY ON LEARNING OUTCOMES THROUGH ASSEMBLER EDUCATION APPLICATIONS IN ELEMENTARY SCHOOLS

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Abstract

The Society 4.0 era is characterized by integrating technology into various sectors, including education, to improve learning effectiveness. One technology that has great potential in supporting the learning process is Augmented Reality (AR), which allows interactive and concrete visualization of abstract concepts. This study examines the effectiveness of using AR-based learning media through the Assembler Edu application in improving student learning outcomes in IPSA (Natural and Social Sciences) subjects at the elementary school level. The research approach used is quantitative with a pre-experimental one-group pretest-posttest Design to measure the effect of AR media on student understanding. The subjects of this study were 30 grade V students at MIN Kota Bima. Data collection techniques were conducted through tests, observations, interviews, and documentation. The results showed a significant increase in student learning outcomes, with an average pretest score of 54.16 and a posttest score of 85.5. The N-Gain value reached 0.78 or 78.01%, which is included in the high category. This finding shows that using the Assembler Edu application can improve students' understanding of abstract concepts in IPAS, encourage learning motivation, and create a more interesting and interactive learning experience. This research is expected to contribute to learning innovation at the elementary school level and become a reference for educators in choosing the right digital learning media.

Keywords: augmented reality, assembler edu, learning media, IPAS, education.

INTRODUCTION

The Society 4.0 era is part of the fourth industrial revolution, characterized by the emergence of the integration of cutting-edge technologies such as the Internet of Things (IoT), Big Data, and Artificial Intelligence (AI). This technology significantly impacts various sectors, including education (Harahap, 2019). Integrating technology into the classroom has become very important, especially to improve learning effectiveness and facilitate the administrative process (Chairudin et al., 2023). In this era, educators must improve their ability to utilize technology so that the learning process can run effectively and efficiently (Khoiriah, 2023). Implementing technology in

education has become very urgent, such as using digital-based learning media. This is very helpful for teachers and students in understanding the material being taught (Moto, 2019). The use of technology in education includes functions as learning media and learning resources (Lestari, 2018).

Students' cognitive development is at the concrete operational stage in the primary school level, particularly for those between the ages of 7 and 11. Children at this age typically better understand learning concepts through real objects or concrete visualization (Marinda, 2020). In addition, children learn to understand basic concepts and begin to develop more complex thinking skills. (Islam & Mataram, 2024). Therefore, a creative teacher is adept at developing ideas or concepts, either by modifying current learning aids, media, or teaching materials, to achieve superior results compared to previous results. (Ridwan, Murzal et.al., 2024). Educational materials that can show ideas realistically are essential to support learning, especially in subjects that contain abstract concepts such as Natural and Social Sciences (IPAS). According to Mulyawati (2022) Students have different knowledge, understanding, and learning styles in one class. To achieve an optimal learning process, interesting strategies designed by educators are needed, such as the use of learning models and methods (Jean Imaniar Djara et al., 2023). One effective method is using learning media as a communication tool in education. (Saleh & Syahruddin, 2023).

In the teaching and learning process, educational media play a strategic role. (Santoso, 2019)Relevant media can enhance students' motivation to learn and provide them with a more concrete approach to understanding the subject matter. (Hasan et al., 2021)However, many educators still struggle to utilize technology optimally, including in choosing appropriate learning media. (Ahmad et al., 2023). Whereas a quality learning process requires the support of relevant and innovative media (Akbar et al., 2022). The success of a good academic process is also determined by a quality learning environment and an effective learning process at school (Hasibuan, 2018).

One technology that has great potential to support learning is Augmented Reality (AR)(Salim et al., 2024)AR is a technology that uses electronic equipment to mix two forms of information: digital and physical. (López-Belmonte et al., 2023). This technology allows students to see interactive three-dimensional visualizations, making abstract ideas easier to grasp. Assembler Edu is one of the platforms that uses

Augmented Reality (AR) in education. (Pagarra H & Syawaludin, 2022). Menurut (Rini et al., 2024) The platform Assembler Edu helps teachers and students design dynamic and captivating educational programs. It also provides a space for students to react, spill their ideas, and increase learning motivation through digital technology.

Augmented reality (AR) technology involves utilizing modern electronic devices to develop thematic visual content that the intended audience can access to meet specific learning objectives (Iatsyshyn & Kovach, n.d.). This media is very appropriate to support the success of student learning. (Iskandar et al., 2023)Assembler Edu allows the creation of Three-Dimensional (3D) content, which has the advantage of displaying objects in full and providing clear illustrations of them. (Lino Padang et al., 2022). Assembler Edu allows students to understand abstract concepts visually through interactive 3D models. For example, students can study ecosystems by seeing the relationships between organisms through virtual models that can be explored via mobile phones. This helps students, especially those with visual and kinesthetic learning styles, to understand concepts more deeply and enjoyably. (Chairudin et al., 2023).

Although Augmented Reality (AR) technology is increasingly applied in education, its application at the elementary school level, especially in learning IPAS (Natural and Social Sciences), is still minimal. Some research, such as that conducted by (Azmi et al., 2024). These studies show that AR has the potential to improve student interaction and concept understanding. However, these studies generally focus on secondary or higher education levels and have not specifically examined the use of AR through the Assembler Edu platform in the context of IPAS learning in elementary schools. (Ahmad et al., 2023)It shows that many elementary school teachers are still not familiar or confident in using AR-based technology. Hence, its utilization in learning activities is still minimal. This research aims to fill the gap by exploring the practical and pedagogical impact of using Assembler Edu applications in IPAS learning. The novelty of this research lies in its focus on contextual implementation at the primary school level using one particular AR platform and its attempt to bridge the digital literacy gap among teachers through targeted applications.

Based on preliminary observations conducted at Madrasah Ibtidaiyah Negeri (MIN) Kota Bima, Augmented Reality (AR) based learning media using Assembler Edu has never been used as a learning medium. Despite the results of interviews with several

IPAS subject teachers, Augmented Reality (AR) based learning media using Assembler Edu has never been applied. This learning media is still unfamiliar to educators. For this reason, this learning media is important to be applied in schools and madrasas that have adequate facilities because this media is used through technology. Augmented reality (AR) can provide convenience for a teacher in delivering material, abstract material, positively impacting students in understanding the learning material well.

MIM Kota Bima is an elementary school with facilities such as LCDs in each class and supportive teaching methods. However, learning IPAS at MIM Kota Bima still faces challenges, especially in conveying abstract concepts such as ecosystems, natural processes, or the water cycle. The learning methods used, such as PowerPoint presentations, audio-visuals, lectures, and textbooks, tend to be monotonous for students. By introducing Augmented Reality (AR) based learning media using Assembler Edu, students are expected to be more motivated and understand the IPAS material better through the visualization and interaction offered by this technology. This research is important to determine the influence of "The Use Of Augmented Reality (AR) Based Learning Media Through Assembler Edu Application In Learning Ipas". The results of this study are expected to make a real contribution to learning innovation, especially at the elementary school level, and become a reference for educators in choosing learning media.

LITERATURE REVIEW

Learning media

According to Hilhard Bower, in jurnal (Mukhalalati et al., 2022) Learning is related to changes in a person's behavior towards a situation caused by their repeated experiences in that situation, where the tendency of the innate response to maturity cannot explain changes in behavior. Learning media is an important tool in supporting an effective learning process. Along with the development of technology in the Society 4.0 era, learning media is no longer limited to conventional visual aids, but also involves digital technology such as e-learning, virtual reality, and augmented reality. (Sanjeev & Natrajan, 2021). According To (Hasan et al., 2021)Using relevant media can increase learning motivation and help students understand concepts more concretely. However, many teachers still struggle to utilize digital media optimally. (Ahmad et al., 2023).

Augmented Reality (AR)

Augmented Reality (AR) is a technology that combines the real world with virtual elements in the form of visuals, sound, and interactivity in real-time. (Bower et al., 2014)Augmented Reality (AR) is the result of technology that can combine the virtual and real worlds, namely, 3D visualization, animation, and information.(Sri Nurlaily Za et.,al., 2021). Augmented reality (AR) is a technology that combines visuals from the virtual world and the real world. Augmented reality (AR) allows users to interact with and view virtual objects directly through their cell phones or laptops. (Joseph et al., 2024)AR does not replace the real world like virtual reality but enriches students' learning experience. It is proven to help visualize abstract concepts in education and increase students' active participation. Salim et al., 2024). Some advantages of AR in learning include: Visualizing abstract concepts in real life, increasing interest and motivation to learn, and facilitating visual and kinesthetic learning styles. However, its use also has challenges: It requires adequate devices and an internet connection. v.

Assembler Edu

Assembler Edu is an AR platform specifically designed for interactive learning. It allows the creation of 3D content to present topics such as the structure of the Earth, the water cycle, and ecosystems—topics common in IPAS subjects.. (Miranda et al., 2020)The use of Assembler Edu has been shown to increase student understanding and engagement, especially in primary education (Sugiarto, 2022; Rini et al., 2024). Assembler Edu's top features include an interactive 3D display, easy access through mobile devices, and no programming skills required. However, its utilization still depends on infrastructure and teacher readiness in designing meaningful content.

METHODOLOGY

This study used a quantitative approach with a pre-experimental design, specifically the One Group Pretest-Posttest Design. This design involves one experimental group of 30 MIN Kota Bima fifth-grade students. Students were given a pretest first to determine the initial understanding of IPAS material, then given treatment in the form of learning using Augmented Reality-based media through the Assembler Edu application, and ended with a posttest to measure the improvement of learning outcomes. (Iskandar et al., 2023). Data collection techniques were carried out through

tests (pretest and posttest), observation of student and teacher activities during learning, interviews to find out student and teacher responses to the use of AR media, and documentation as supporting data. (Scârneci-Domnişoru, 2021). Data collection techniques were carried out through tests (pretest and posttest), observation of student and teacher activities during learning, interviews to find out student and teacher responses to the use of AR media, and documentation as supporting data. (Kholifah & Sofwan, 2024). The test instrument was validated using the Pearson Product-Moment formula, with the items declared valid if the value of $r$count>$r$table. The reliability test was carried out using Cronbach's Alpha, and the instrument was considered reliable if the reliability coefficient was ≥ 0.7

Before analyzing the effectiveness, a prerequisite test was conducted as a normality test using the Shapiro-Wilk test to ensure the data were normally distributed. Data analysis was carried out by calculating the N-Gain Score to determine the effectiveness of the treatment on improving learning outcomes. The formula used is:

$$\text{N-Gain} = \frac{shoes\ posttest - shoes\ pretest}{shoes\ maximum - shoes\ prettest}$$

The N-Gain interpretation categories are as follows: $g \geq 0.7$ is high, $0.3 \leq g < 0.7$ is medium, and $g < 0.3$ is low. The results of this calculation are used to assess the effectiveness of using Assembler Edu media in improving students' IPAS learning outcomes. (Masrifah & Setyasto, 2024).

RESULT AND DISCUSSION

RESULT

The effect of using Augmented Reality (AR) based learning media through the Assembler Edu application is measured using pretest and posttest tests. The pretest was given before the application of AR media, while the posttest was carried out after learning with the media. In addition to quantitative data from the test results, data were obtained through observation, interviews, and documentation to obtain a more comprehensive picture of the learning process. The results of the data acquisition are as follows:
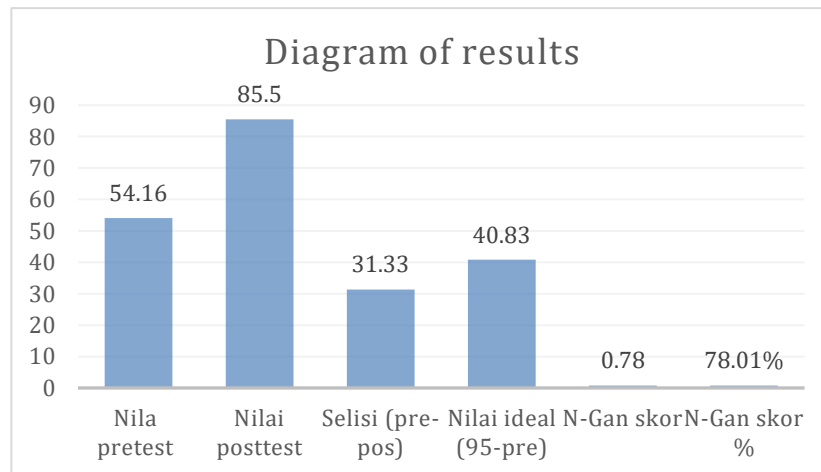
Diagram of Pretest results, posttest, select (pre-post), ideal value (95-pre), N-Gain Score, N-Gain Score% %

A comparative analysis between pretest and posttest scores was conducted to evaluate the improvement of student learning outcomes. This study involved 30 fifth-grade students. The average pretest score obtained was 54.16, reflecting the students' initial understanding of IPAS material before using AR-based learning media. After learning to use the Assembler Edu application, the average posttest value increased to 85.5, which showed a significant increase. The difference in scores between the pretest and posttest is 31.33 points. An analysis was conducted using the N-Gain Score (Normalized Gain Score) to assess the effectiveness of learning. The calculation results showed an average N-Gain value of 0.78, equivalent to 78.01%, which is classified in the high improvement category. This shows that using AR media through the Assembler Edu application effectively improves student learning outcomes. In addition to the average increase, analysis of individual data shows that most students experienced a significant increase in scores, with many N-Gain Score values in the range of 0.7 and above, which indicates the maximum increase from pretest to posttest scores. These results show that AR media supports academic achievement and creates a more interactive and engaging learning experience.

Qualitative data from interviews with fifth-grade teachers also support this finding. The teacher said that students tended to be passive before using AR media and had difficulty understanding abstract concepts such as ecosystems. However, after using the Assembler Edu application, students became more enthusiastic, actively asked questions, and showed better understanding. Teachers also considered this media

beneficial because it presents material visually and interactively, so students can directly see learning objects in three-dimensional form through their devices. Students' responses to the use of AR media are also very positive. They feel more interested and happy in participating in learning because of the interesting visualization and interactive learning experience.

Students stated that with the help of AR, difficult material becomes easier to understand because they can see objects in real time and from various points of view. However, there are some obstacles to the implementation. Teachers and students experienced delays in the application installation process and required stable internet access or data packages. In addition, the long loading time of the application is also a challenge. The results showed that Augmented Reality-based learning through the Assembler Edu application significantly improved student learning outcomes. This media helps students understand abstract IPAS material to be more concrete through attractive three-dimensional visualization. In addition, students also become more enthusiastic, active, and motivated during the learning process.

DISCUSSION

Learning media is one of the important components in supporting the success of the teaching and learning process. In this context, Augmented Reality (AR) based learning media through the Assembler Edu application shows significant potential in helping students understand abstract concepts in IPAS learning. The results of this study show that the use of AR can increase learning interest, student engagement, and facilitate understanding of complex material such as the structure of the Earth, the water cycle, and ecosystems.

This finding aligns with research by Nurhidayanti et al. (2022), which states that AR can visualize abstract concepts through interactive 3D models, thereby increasing students' direct learning experience. This is also supported by Zi-Gang Ge (2021), who confirms that media such as images, animations, and videos effectively reduce students' visual difficulties, thereby reinforcing learning. In addition, a study by Indahsari & Sumirat (2023). stated that the use of AR has extensive benefits, such as increasing motivation, engagement, and understanding of concepts. However, they also highlighted challenges that may arise, such as limited infrastructure and teacher readiness. AR has

been developed in various fields with many applications. AR is a complex system that introduces a virtual presence into the reality of use (Herron, 2016). AR can also be used as a teaching aid and as an alternative medium to assist learning (Jan et al., 2023). In the context of this study, teachers at MIN Kota Bima overcame these obstacles by utilizing simple devices (laptops and smartphones) and utilizing the "free" feature of Assembler Edu to remain efficient and accessible.

This research also corroborates the findings of (Álvarez-Huerta et al., 2021) Assembler Edu effectively increases students' participation and creativity, as the app not only displays 3D models but also allows students to explore and create digital content independently. This interactive feature aligns with the student-centered learning approach, where students actively participate in the learning process. However, there are some important caveats. Although AR technology offers an immersive and fun learning experience, its implementation still requires readiness from technical and pedagogical aspects. This is reinforced by (Ramadhan et al., 2024) This emphasizes that teachers must have a basic understanding of the use of applications and appropriate teaching strategies for AR integration to be effective. Thus, it can be concluded that Augmented Reality-based learning media through Assembler Edu is innovative and adaptive to the learning needs of IPAS. This finding contributes to strengthening the literature on digital technology use in basic education. It opens space for further research on optimizing AR media in various other learning contexts.

Figure 1. Student activities in using Augmented Reality (AR) based learning media through the Assembler Edu application

CONCLUSIONS

Based on the research findings, the use of Augmented Reality (AR) based learning media through the Assembler Edu application significantly improves the learning outcomes of grade V students in IPAS subjects at MIN Kota Bima. The average score increased from 54.16 (pretest) to 85.5 (posttest), with an N-Gain value of 0.78 (78.01%), which is classified in the high category. This shows that AR media is effective in helping students understand abstract concepts such as ecosystems and the water cycle through attractive and interactive 3D visualizations. In addition to improving cognitive understanding, using Assembler Edu also arouses students' interest and enthusiasm for learning. Students become more active and engaged in learning, while teachers find it easy to deliver complex material visually. Although there are technical constraints, such as internet connection and application loading time, the learning benefits remain dominant. Thus, AR-based learning media such as Assembler Edu are a potential innovation worthy of further development, especially at the elementary school level. This media can bridge the limitations of conventional methods in delivering abstract material and is in line with the demands of education in the Society 4.0 era. Therefore, training and infrastructure support are needed so that more teachers can optimally implement this technology.

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