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The Influence of Augmented Reality on Students' Understanding in Science Learning Through 3P Model

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Abstract: This research aims to 1) describe students' understanding with the application of conventional media; 2) describe students' understanding with the application of augmented reality media; and 3) compare the differences in student understanding between the use of conventional and augmented reality media. This quasi-experimental research employs a quantitative approach, involving two groups: an experimental group and a control group. The study examines two variables: the independent variable is the application of augmented reality through the 3P model, and the dependent variable is student understanding. The research was conducted at Jepanpakis Elementary Schools 1 and 3, with a sample of 39 students selected through random sampling. Data collection techniques included tests and documentation. The results indicated an improvement in learning outcomes, as measured by student understanding, in the experimental group using augmented reality media, with an increase of 2.89%. Before the treatment, the average student score in the experimental group was 54.67, which increased to 84.38 after the post-test. In the control group using conventional media, the average pre-test score was 54.67, which increased to 69.33 in the post-test. The gain score test results showed a high category increase of 0.70 in the experimental group, compared to a low category increase of 0.32 in the control group. The conclusion of this research is that there is a significant difference in student understanding between the use of augmented reality media and conventional media.

Keywords: Influence, Augmented Reality, 3P Model, science

1. Introduction

In the era of Industry 4.0, technology plays a significant role in making human activities more effective, especially in the field of education. Innovations in learning methods are being introduced by educational institutions and governments to support the learning process. One such technology used in elementary schools is Augmented Reality (AR). AR is a unique system in the field of information technology that combines real objects with digital objects without altering the original form of the real objects (Mukti, 2019). AR technology is expected to transform learning from being solely teacher-centered to fostering interactive learning between teachers and students, thereby enhancing learning performance (Lee, 2012).

AR technology offers an engaging and enjoyable learning alternative for elementary school students. These students are characterized by their love for movement, play, direct experimentation, and group activities (Ningsih, 2019). Natural Science (IPA) is a subject that involves studying nature and the surrounding environment, focusing on natural phenomena and objects. The science learning process emphasizes direct experience to develop students' competencies in exploring and understanding the natural world. The Elementary Education Unit Level Curriculum (KTSP) states that science learning involves not only acquiring knowledge but also developing scientific concepts and attitudes, fostering curiosity, positive attitudes towards the relationship between humans and nature, and raising environmental awareness (Wulandari et al., 2021). Science is thus an essential subject for daily life, supported by advancements in knowledge and technology (Munir & Darmanto, 2022).

From my observations, I have found that teachers still use conventional media in their teaching, resulting in low student understanding of the material, particularly regarding the human circulatory system. This has led to lower science grades when students are tested on real-life applications of the subject matter. To address this issue, I am exploring solutions to improve science learning by enhancing student understanding through interactive and technology-based methods. This includes fostering interactive connections between teachers and students or among students themselves

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(Purbasari et al., 2022). Teachers need to be prepared with models and media to support science learning. AR media, through the 3P model (Presage, Process, and Product), is one such medium where teachers can explore students' initial potential to prepare them as excellent learners.

Effective learning involves communication between teachers and students to achieve learning objectives. According to Rizki et al. (2022), learning outcomes depend on how well students comprehend the material presented by the teacher. Utomo (2021) further suggest that learning outcomes are influenced by internal factors (such as intelligence, physiology, attitudes, interests, talents, and motivation) and external factors (such as the school environment, family environment, and public environment). Teachers must adapt their teaching models, strategies, and media to current conditions to enhance learning. A cooperative approach among students is necessary to master and understand the material effectively. Utilizing advanced technology like AR can make learning more engaging and productive. AR combines students' prior knowledge with structured lesson stages, allowing teachers to tailor the material to the students' understanding levels and ultimately produce successful learning outcomes.

AR involves integrating real-world objects with virtual 2D or 3D objects displayed in the real world, often referred to as anchored reality. AR applications are typically implemented on smartphones, where the technology works by detecting images called markers using the smartphone's camera (Jesionkowska et al., 2020). The 3P model focuses on exploring students' potential at the start of learning, choosing appropriate teaching methods during the learning process, and producing tangible learning outcomes at the end. Using AR media through the 3P model in teaching the circulatory system to fifth graders in elementary school aims to improve student understanding and learning outcomes.

The objective of this research is to analyze the influence of AR media on the understanding of fifth-grade students in science learning, specifically the circulatory system, through the 3P model (Presage, Process, and Product). The data obtained will be used to determine the effectiveness of using appropriate media and methods in improving student understanding in science subjects.

2. Literature Review

Augmented Reality (AR) is an emerging technology that enhances the user's real-world environment by superimposing virtual objects, thus creating an interactive and engaging learning experience. AR has been increasingly integrated into educational settings, particularly in science learning, where it offers unique opportunities to visualize complex concepts and phenomena. Köse and Güner-Yildiz (2021) define AR as a technology that enhances the user's field of vision with necessary information through computational processes that transform and chart graphics in real-time. Skarbez et al., (2021) further describe AR as any situation in which real environments are augmented with virtual objects. Azuma views AR as a variation of virtual environments enabling users to see reality through superimposed objects. AR has experienced significant growth in education, with systematic reviews indicating its potential to enhance teaching and learning processes. Studies have shown AR's positive impact on motivation, attention, attitude, conflict resolution, comprehension, learning efficiency, and performance. AR can also facilitate new ways of showing relationships and connections for learning, incorporating image and video animations into educational content.

The 3P model, proposed by Biggs, describes the learning process through three components: Presage, Process, and Product. This model helps analyze students' perspectives and learning experiences: 1) Presage: Involves student characteristics and teaching context; 2) Process: Includes learning strategies, student motivation, and the use of AR; and 3) Product: Focuses on satisfaction and academic performance (Kanashiro et al., 2020). The ARCS model (Attention, Relevance, Confidence, Satisfaction) by Keller complements the 3P model by addressing motivational factors in the learning process. AR-based activities designed according to the ARCS model can enhance student engagement and learning outcomes (López-García et al., 2019).

3. Methodology

This study is quantitative research utilizing a quasi-experimental design. The research aims to compare the effects of different teaching methods on student understanding by involving two groups: an experimental group and a control group. The experimental group received science learning treatment using AR media through the 3P model, while the control group received conventional media-based learning treatment.

The instruments used to gather research data included tests and documentation. The tests consisted of a pretest and a posttest to measure student understanding before and after the treatment. Documentation involved observing and recording the learning activities conducted by the researchers. The population for this study comprised all fifth-grade students in Jepangpakis Village, totaling 58 students. The sample was selected using random sampling techniques, resulting in 21 students from Class V at SD 1 Jepangpakis and 18 students from Class V at SD 3 Jepangpakis.

4. Results and Discussion

Preliminary data obtained from tests conducted on students in both the experimental and control classes are as follows. Based on Table 1, the average initial scores of student understanding were 55.43 for the experimental class and 54.67 for the control class, indicating that both classes had relatively low understanding initially. After the posttest, the average score for the experimental class increased to 84.38, while the control class achieved an average score of 69.33. This

demonstrates that the experimental class, which used AR media, had a significantly higher average score compared to the control class. Hypothesis testing was conducted after all prerequisite tests, including normality and homogeneity tests, were fulfilled. An independent sample t-test was used to compare the results. With a significance level of 0.05, the hypothesis test indicated that if t calculated > t table, then H_a is accepted and H_0 is rejected.

Table 1. Pretest and posttest scores results study in the form of student understanding to class science material experiments and classes control

Data	Class	N	Ideal Score	Min Score	Max Score	Average	(%)	Note
Initial	E	21	100	40	84	55.43	55	C
Test	K	18	100	40	80	54.67	56	C
Final	E	21	100	76	100	84.38	84	B
Test	K	18	100	60	80	69.33	69	C

From the results in Table 2, the independent sample t-test indicated the following: t (40) = 5.033, p < 0.001, with a mean difference of 11.048, and confidence intervals ranging from 6.611 to 15.484. These results, displayed in the "equal variances assumed" column, demonstrate that the data is homogeneous. The calculated t-value of 5.033 is greater than the critical t-value of 2.042, and the significance value of 0.000 is less than 0.05. Therefore, the null hypothesis (H0) is rejected, confirming that AR (augmented reality) media has a significant effect on the understanding of fifth-grade science students.

Research conducted by Gun and Atasoy (2017) supports these findings, showing that the use of AR media in 3D forms installed on mobile phones enhances students' spatial abilities and academic achievement. Similarly, Ningsih (2019) found that using AR media in learning positively impacts students' understanding of concepts in science. The results of López-García et al. (2019) also align with this study, indicating that AR applications designed through the 3P model yield satisfactory outcomes in learning. Based on these findings and expert opinions, as well as relevant research, AR media and the 3P model are more effective in improving students' understanding of science compared to conventional media. In conclusion, the significant influence of AR media on students' understanding of science learning through the 3P model for fifth-grade elementary students has been proven.

Table 2. Results of t-test analysis

		t-test for Equality of Means						
		Q	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
Mark	Equal variances assumed	5,033	40	0,000	11,048	2,195	6,611	15,484
	Equal variances not assumed	5,033	38,913	0,000	11,048	2,195	6,607	15,488

5. Conclusion

Based on the results and discussion, it can be concluded that the use of AR media significantly enhances students' understanding of science learning through the 3P model for fifth-grade students. The findings demonstrate that AR media and the 3P model are effective tools for improving students' comprehension in science education. The following suggestions are made: 1) Augmented reality media can be more effective if used according to the proper procedures; 2) Teachers should prepare thoroughly to deliver material effectively using augmented reality media, considering the educational level and various learning resources available.

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