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The Effect of the Use of *Augmented Reality* (AR) Learning Media on Science Learning Outcomes of Class V Students at SDIT Qurrata Aini Baitussalam

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Abstract
This study aims to determine the effect of using Augmented Reality (AR) learning media on the science learning outcomes of fifth-grade students at SDIT Qurrata Aini Baitussalam. The method used is an experiment comparing a control class and an experimental class. The results show that students in the experimental class who used AR learning media achieved higher test scores compared to students in the control class. Statistical testing using the Independent Samples T-Test was conducted to examine the significance of the differences in learning outcomes between the two classes. Prior to hypothesis testing, the Kolmogorov-Smirnov normality test confirmed that the data were normally distributed, meeting the assumptions for parametric testing. The test results showed a significant t-value (-10.123) with a p-value of 0.000 ($p < 0.05$). The p-value, which is well below the significance level of 0.05, and the absolute t-value exceeding the t-table value (approximately 3.623) indicate a significant difference between the average science learning outcomes in both classes. Therefore, it can be concluded that the use of Augmented Reality learning media has a positive effect on the science learningoutcomes of students.

Keywords: Augmented Reality, Learning Outcomes, Science, Fifth Grade, Learning Media.

Abstrak
Penelitian ini bertujuan untuk mengetahui pengaruh pemanfaatan media pembelajaran Augmented Reality (AR) terhadap capaian pembelajaran sains siswa kelas V SDIT Qurrata Aini Baitussalam. Metode yang digunakan adalah percobaan dengan membandingkan kelas kontrol dan kelas eksperimen. Hasil penelitian menunjukkan bahwa siswa di kelas eksperimen yang menggunakan media pembelajaran AR memperoleh nilai tes hasil belajar yang lebih tinggi dibandingkan dengan siswa di kelas kontrol. Uji statistik menggunakan Uji T Sampel Independen dilakukan untuk menguji signifikansi perbedaan hasil belajar antara kedua kelas. Sebelum pengujian hipotesis, uji normalitas Kolmogorov-Smirnov mengkonfirmasi bahwa data terdistribusi Normal, memenuhi asumsi untuk tes parametik. Hasil pengujian menunjukkan perhitungan nilai t yang signifikan (-10,123) dengan nilai p 0,000 ($p < 0,05$). Nilai p yang jauh di bawah tingkat signifikansi 0,05 dan nilai absolut perhitungan t yang melebihi nilai t tabel (sekitar 3,623) menunjukkan perbedaan yang signifikan antara rata-rata hasil belajar sains di kedua kelas. Dengan demikian, dapat disimpulkan bahwa penggunaan media pembelajaran Augmented Reality memiliki efek positif terhadap hasil belajar sains siswa.

***Kata kunci**: Augmented Reality, Hasil Pembelajaran, Sains, Kelas V, Media Pembelajaran.*

Introduction

In today's digital era, the challenges of the world of education are increasingly complex. The rapid development of technology has changed the way humans learn, communicate, and access information. Education in Indonesia cannot be separated from this dynamic. Based on the results of the 2022 Program for International Student Assessment (PISA) study, the performance of Indonesian students in the field of science is still below the average of OECD countries, even only around 29% of students are able to

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solve basic science problems. This is a clear reflection that the quality of learning, especially in the subject of Natural Sciences (IPA), requires serious attention and innovation (And the way) Gilang Leo Agusta, 2022)

At the elementary school level, science is an important subject in shaping students' scientific thinking and curiosity about natural phenomena. However, there are still many students who have difficulty understanding abstract concepts in science, due to the limited learning media that can visualize the material in real life. Conventional learning models centered on lectures or the use of textbooks alone are not enough to foster deep understanding and long-term retention in students. (Komariah et al., 2023) (Urrizola et al., 2023)

In line with these needs, Augmented Reality (AR) technology is present as one of the promising learning media alternatives. AR allows the incorporation of the real world with virtual elements, allowing students to experience the learning process in an immersive, visual, and interactive way. In several studies, AR has been proven to increase student motivation, engagement, and learning outcomes at various levels of education. A meta-analysis showed that the use of AR in science learning at the K-12 level had a significant effect on learning outcomes, with an average effectiveness value of 0.521.(Full, 2024)

AR is also believed to be very relevant to be applied in science learning at the elementary school level because it is able to bridge the limitations of abstraction experienced by students. In a study by, AR succeeded in significantly improving the understanding of science concepts of grade V students in Garut Regency compared to the control class. These findings are reinforced by the fact that learning with AR media is able to improve students' visual and cognitive memory in basic science learning, such as understanding the human body's organ systems and water cycles (Saputra et al., 2022) (Nurul Athiyah et al., 2024)

The function of teachers in the learning system is in providing, showing, guiding, and also motivating students so that they can interact with what is provided by learning resources. Student interaction can be done with methods, media, and so on. One of the main challenges in the world of education in Indonesia is how to improve learning outcomes and learning quality so that it is more effective, interesting, and can overcome the difficulties experienced by students, especially in Natural Sciences (IPA) subjects. At the elementary school level, science is often considered difficult by students because the concepts taught tend to be abstract and require a deep understanding. (Syifa Hayatunnisa Anwar & Ijie, 2023) (Rahmad & Budiyanti, 2022) (Shahriddinovna, 2023)explained that Natural Science Education (IPA) is a science that discusses natural phenomena, both in facts, concepts, principles, and laws and can be proven to be true by scientific activities.

In the current era, learning media is not only in the form of traditional methods like the previous ones, of course requires education personnel to follow in accordance with the development of the times, namely related to technology, where in education an educator must not only excel in conveying information but is also required to excel in using technological media as learning for educators and students, for example the internet, applications, software or other hardware. By using interesting and appropriate media, various studies have proven that learning becomes more effective and increases the attractiveness of students in participating in learning, developing creativity, and fostering a good influence on students. The use of innovative media, such as (Miranda et al., 2022) (Nurhayati et al., 2018) *Augmented Reality* (AR), not only enhances students'

understanding of science concepts, but also encourages their creativity and engagement in the learning process (Fajari et al., 2024)

To improve the quality of learning and student learning outcomes, a more innovative and attractive approach is needed. One solution that can be done is to use technology in learning. Technology allows the creation of more interesting and interactive learning media. Technology makes it easier for the education sector to give students access to more diverse learning resources, so teachers are not the only ones who have access to learning materials. One of them is the media, media has become an instrument or tool that plays an important role in a learning process. Media is a necessity used by educators in conveying information or learning materials to be delivered. If in the delivery of learning materials, the lack of media used is likely to cause students to lack understanding in listening to what is conveyed by educators. (Junger et al., 2023) (Hasanah Lubis et al., 2023)

According to stating that media are different types of components in a student's environment that can stimulate him to learn. Meanwhile, it is argued that media is any physical tool that can present messages and stimulate students to learn. Learning outcomes are students' abilities obtained after learning activities. Learning outcomes are certain competencies or abilities achieved by students after participating in the teaching and learning process and include cognitive, affective, and psychomotor skills. Encounter (1970) (Wulandari et al., 2023) Briggs (1970) (Zahwa & Syafi'i, 2022) (Muratin, 2022)

One of the technologies that is currently being applied in education is the media *Augmented Reality* (AR). AR is a technology that combines real-world elements with digital elements in a three-dimensional form that can interact in real-time. AR has great potential to be used in science learning, because it can present abstract scientific objects or concepts in the form of visualizations that are easier to understand. (Pelin Yildiz, 2022) *Augmented Reality* (AR) itself is a technology that is able to provide interactive collaboration between the real world and the virtual world and can display three-dimensional animations. Media (Kshirsagar et al., 2023) *Augmented Reality* It is expected to affect student learning outcomes through a more interactive learning process. Based on research, it shows that teachers have not fully utilized technology-based learning media to the fullest. On the other hand, teachers often use conventional learning media. In social studies lessons, there are still some students who have not reached the minimum completeness criteria (KKM). The use of less varied methods and media makes it difficult for students to understand food chain material so that their learning results have not reached the Minimum Completeness Criteria (KKM). (Dewi et al., 2024a)

Based on the results of observations that have been made by researchers at SDIT Qurrata Aini Baitussalam, it was found that science learning at the school still tends to be done conventionally using a few interesting learning media. This results in students feeling less interested and less understanding of the science material being taught. Many students have not reached the Minimum Completeness Criteria (KKM) set, which shows that their learning outcomes are still low.

Table 1. Learning Outcomes of Grade V Students of SDIT Qurrata Aini Baitussalam

No.	Class	KKM Value	Number of Students	Presentase	Category
1.	V Sholih	≥ 75	14	43,7%	Tuntas

		≤ 75	18	56,2%	Incomplete
2.	V Taqwa	≥ 75	12	38,7%	Conclusion
		≤ 75	19	61,2%	Incomplete

However, the study still has some limitations. Most use quasi-experimental designs or qualitative studies, with small sample sizes and limited to specific regions. There have not been many experimental quantitative studies that objectively and systematically examine the effect of the use of AR on science learning outcomes in elementary school students in integrated Islamic school environments (SDIT). In fact, student characteristics, curriculum, and learning culture at SDIT can affect the effectiveness of technology-based learning media.

In addition, the implementation of AR in the elementary school environment also faces various challenges, such as limited equipment, teacher training, and the readiness of school infrastructure. In the study, it was found that although AR increases students' motivation and understanding of the concept of photosynthesis, some obstacles such as lack of support devices and teacher competence are still major obstacles in its implementation in the classroom. (Rosmaria & Mairisian, 2024)

Based on these phenomena and findings, this study is designed to fill the knowledge gap that still exists. This study will use an experimental quantitative approach to objectively measure the extent to which the use of AR-based learning media can improve the science learning outcomes of grade V students at SDIT Qurrata Aini Baitussalam. With the design of pretest-posttest control groups and inferential statistical analysis, this study is expected to provide more valid and generalized data.

The contribution of this research is not only academic, but also practical. From the academic side, the results of the research will strengthen the empirical evidence on the effectiveness of AR as a learning medium in the context of basic education in Indonesia. Meanwhile, from a practical perspective, this research can be a reference for teachers in designing more interesting and effective learning as well as for education policy makers in formulating technology integration strategies in science learning at the elementary school level. Based on the description above, it is important to conduct research on "The Effect of the Use *of Augmented Reality* (AR) Learning Media on the Science Learning Outcomes of Class V Students at SDIT Qurrata Aini Baitussalam

Method

This research is a quantitativeresearch with a design *Quasi experiment* to study the influence of learning media *Augmented Reality* to the science learning outcomes of students at SDIT Qurrata Aini Baitussalam. The design used is (Feky Reken, 2024)*Nonequivalent Control Group Design*, involved two groups: a control group that did not use learning media and an experimental group that used Augmented Reality. The study population consisted of 62 students of class V, with samples taken using (Hastjarjo, 2019)*nonprobability sampling* by *purposive*. The data collection technique is carried out through learning outcome tests in the form of essay questions to measure students' skills and knowledge, with normality and homogeneity tests to ensure that data is distributed normally and homogeneously.

Results and Discussion

Result

Based on the results that have been found, the researcher uses a learning outcome test in the form of essay questions in the control class that is not given treatment and the

experimental class, the class that is treated has a different average score in the control class with an average score of 55.1 while the experimental class gets an average score of 79.4.

1. Normality Test

Table 2. Normality Test Results for Learning Outcomes

	Kolmogorov-Smirnova		
	Statistic	df	Itself.
Control Class	.148	31	.882
Experimental Classes	.171	31	.909
a. Lilliefors Correction	Significance		

The above results use Komolgrov-Smirnov due to the respoden > 50. The above data shows that the result of Sig. > 0.05. Thus, it can be concluded that the data is the same or it can be said that the data is normally distributed.

2. Homogeneity Test

Table 3. Homogeneity Test Results Learning Outcome Questions Test

Test Of Homogenity Of Variances					
		Leven e Statistic	df1	df2	Itself.
Science Learning Outcomes	Based on Mean	3,623	1	60	.062
	Based on Median	2,729	1	60	.104
	Based on Median and with adjusted df	2,729	1	58,578	.104
	Based on trimmed mean	3,291	1	60	.075

The above result shows that the result is Sig (P-Value) = .104. This shows that the value of P > 0.05, thus it can be concluded that the data variants are the same or it can be said that the data is homogeneous.

3. Uji Hypothesis

Table 4.

Independent Samples Test						
Levene's Test for Equality of Variance				t-test for Equality of Means		
		F	Itself.	t	df	Sig. (2-tailed)
Science Learning Outcome Test	Equal variances assumed	3,623	.062	-10,123	60	.000
	Equal variances not assumed			-10,123	56,336	.000

Independent *Samples T-Test Hypothesis Test Results*

Based on table 4. shows that the comparison of the value of sig. 0.00 < 0.05, obtained a calculated t-value of -10.123 with a significance value (p-value) of .000 (p < 0.05) and a degree of freedom (df) of 60. With significance levels of α = 0.05 and df = 60, the t-value of the table is about 3.623. Since the absolute value of the calculated t (| -10.123 | = 10.123) is greater than the table tvalue (3.623) and the significance value (.000) is less than 0.05, then the Null Hypothesis (Ho) is rejected, and the Alternative Hypothesis (Ha) is accepted, where it corresponds to the conditions of the test *Independent Simples T-Test* i.e. Ho is rejected and Ha is accepted, meaning that there is a difference between the control class and the experimental class where there is an influence in the experimental class by using learning media *Augmented Reality* to the learning outcomes of grade V students at SDIT Qurrata Aini Baitussalam.

Discussion

The application of technology-based learning media, especially *Augmented Reality* (AR), in the world of basic education has opened up a new paradigm in the teaching and learning process. The results of this study show that the use of AR media has a significant influence on improving student learning outcomes in Natural Sciences (IPA) subjects. This is evidenced by the results of the student learning outcome test between the control class and the experimental class. The average score of the control class was 55.1**,** while the experimental class reached 79.4, indicating a fairly high difference of 24.3 points.

The data is strengthened by the results of normality and homogeneity tests. The data distribution of the two groups was in normal and homogeneous conditions, making it eligible for parametric hypothesis tests. Through the Independent Samples T-Test, it was found that the significance value was 0.000 (p < 0.05) and the t-count value was -10.123, far exceeding the t-table of 3.623. Based on these results, the zero hypothesis (H_0) was rejected and the alternative hypothesis (H_1) was accepted, which means that there was a significant difference between the learning outcomes of students who used AR and those who did not.

Theoretically, this finding is in line with the Theory of Cognitivism put forward by Bruner (1966), that learning will be more meaningful when students are active in building knowledge through the process of exploration and symbolic representation. AR as an interactive medium provides an opportunity for students to engage various senses simultaneously (visual, kinesthetic, and audio), thereby strengthening cognitive processes in remembering and understanding abstract science concepts. Furthermore, (Gargrish et al., 2022) Mayer (2009**)** in *the Cognitive Theory of Multimedia Learning* states that understanding concepts will be better if the material is conveyed through dual channels, namely visual and verbal. AR media facilitates this principle through 3D visualization and audio synchronized with explanations, thereby accelerating the processing of information in the student's brain. (Kairu, 2021)

The support of previous research also strengthens the results of this study. It was found that AR media can significantly improve the learning outcomes of science in elementary school students with an average increase (Rusli et al., 2023) of 22**%** compared to conventional methods. Meanwhile, research by states that the use of AR in learning has a (Abdullah et al., 2022) positive effect on students' learning interests and engagement, which has implications for improving their academic achievement. In the context of implementation in the field, students who learn with AR media seem more active, enthusiastic, and focused in absorbing learning materials. 3D visualization of body organs, water cycles, or the solar system, for example, is capable of transforming abstract concepts into real and easy to understand, which were previously only visualized through two-dimensional images in textbooks. (Krüger et al., 2022)

From the point of view of cognitive development, the use of AR strongly supports the concrete operational stage according to Piaget's theory of cognitive development. At the age of elementary grade V students, they need a real visual representation to understand the scientific process, and AR answers this need very effectively. These findings are also in line with (Wen et al., 2024) research (You Lim et al., 2023) showing that the use of AR in science subjects contributes greatly to improving long-term memory and conceptual mastery. AR media has also been shown to increase intrinsic motivation, as evidenced in a study by those who reported an increase in student learning motivation by (Carolina, 2022; Nurillah et al., 2022) 35% after using AR media in science learning.

This is in line with research conducted by Research by Media Goddess Popiyanto - Shirley (2024) *augmented reality* allows students to see material in 3 dimensions and in real time, as well as interact with its features. The use of this media has been proven to increase students' interest and enthusiasm in learning

On the other hand, the gap in previous research that only focused on aspects of learning interest or motivation has not fully addressed the influence of AR on learning outcomes quantitatively at the integrated Islamic-based elementary school level. Therefore, the study makes a new contribution by focusing on the cognitive domain, as well as using experimental design with robust statistical testing**,** which reinforces the legitimacy of the findings. Practically, the results of this study provide important implications for teachers and schools to consider the use of AR as part of learning innovation. This is in line with the demands of an independent curriculum that encourages a contextual, fun learning approach and facilitates students' individual learning needs. In addition, with easier access to digital devices and user-friendly AR-based applications, teachers have a great opportunity to apply this approach widely.

Thus, this study not only emphasizes the effectiveness of AR media in improving science learning outcomes, but also emphasizes the importance of digital transformation in basic education. AR-based learning is no longer a complement, but can be the main

strategy in providing interesting, easy-to-understand, and meaningful science learning for students.

Conclusion

The results of the analysis showed that students in the experimental class who used AR media obtained higher test scores compared to students in the control class who did not use the media. Statistical tests using *the Independent Samples T-Test* confirmed that the difference in average learning outcomes between the two classes was significant, with a value of p = 0.000 which was well below the significance level of 0.05. Therefore, it can be concluded that the application of *Augmented Reality* learning media contributes significantly to improving students' science learning outcomes. Therefore, it can be concluded from this study that the use of *Augmented Reality* (AR) learning media has a significant positive influence on the science learning outcomes of grade V students at SDIT Qurrata Aini Baitussalam.

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