

Application of 3D-AIR Media on Lithosphere Material for Class X Students at Senior High School 8 Banjarmasin

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Abstract

This study aims to evaluate the effectiveness of 3D-AIR media in enhancing students' geography learning outcomes at SMA Negeri 8 Banjarmasin. This type of research uses an experimental design with a nonequivalent pretest-posttest control group design. The sample for this study consisted of students in class X.5 (experimental) and X.6 (control) in the 2024/2025 academic year. The experimental class received treatment with 3D-AIR media, while the control class did not use any learning media. The material taught in this study was the lithosphere. The data collection technique used a multiple-choice test. The data were analyzed using the Mann-Whitney test, which showed that the Asymp. Sig. (2-tailed) of $0.861 > 0.05$ indicates that there is no increase in geography learning outcomes through 3D-AIR media in class X students at SMA Negeri 8 Banjarmasin. This is due to various learning component factors, including 3D-AIR media and supporting facilities used during classroom learning. 3D-AIR media still has shortcomings, namely that it is only compatible with Android-based devices. However, some students use iOS and HarmonyOS-based devices, which can hinder their access to lithosphere materials during learning. Furthermore, Wi-Fi network support in the school environment remains suboptimal, limiting the use of 3D-AIR media in learning. Therefore, research findings on supporting facilities for the application of 3D-AIR media in lithosphere learning are the main focus, to optimize student activities and the quality of geography learning in the technology era.

Keywords: 3D-Air, Lithosphere, Geography, Learning Media

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1. Introduction

The application of learning media is crucial in enhancing the effectiveness of students' learning processes. The rapid advancement of information and communication technology has triggered significant transformations in contemporary education, prompting the emergence of a common challenge for schools in this modern era: the demand for engaging learning media. 3D learning media is a viable, innovative effort to display engaging content and can increase students' learning

effectiveness and motivation. The primary benefit of this media lies in its ability to provide more authentic, interactive, and visually engaging materials, thereby facilitating enhanced communication and interaction between teachers and students, and creating a fun learning experience (Maulidya et al., 2021; Nuraliev et al., 2021; Pratama & Rahmawati, 2022).

Geography learning is the study of geosphere phenomena, including the lithosphere, atmosphere, biosphere, and anthroposphere, from an environmental and regional perspective within a spatial context. However, in practice, geography learning is often perceived by students as boring and difficult. Furthermore, the limited use of learning media results in less interesting and attractive learning, leading to lower learning outcomes and reduced student motivation to learn geography (Franzoni et al., 2013; Tul'adawiyah et al., 2024). The lack of interactive learning media can lead to a boring learning experience, making students passive recipients of information and resulting in low knowledge retention and motivation in the classroom (Elmunsyah et al., 2023; Logenthini Mariappan, 2024). Making the need for good and interesting learning media more profitable, where 3D learning media can provide students with an effective way to improve their understanding of the subject matter.

Based on observations at SMA Negeri 8 Banjarmasin, it was found that geography learning outcomes were low, there was a lack of geography learning media, and students' enthusiasm and motivation were quite low. This was reinforced by several students' statements that the geography material, such as the lithosphere, was very difficult to understand. Lithosphere material is included in the Merdeka curriculum in KD 3.5, which analyzes the lithosphere's dynamics and its impact on life. Media can concretize the material using technology, so that students have a real picture of phenomena and their contexts (Allen-Robertson, 2017; Bokingo et al., 2023; Larasaty et al., 2024). Media that can improve understanding of geography knowledge, such as augmented reality, Google Maps, maps, and three-dimensional media (Aristin et al., 2020; Hilman & Mainaki, 2020; Huang et al., 2013; Sambonu et al., 2023). Therefore, to answer these challenges and problems, learning media technology in the form of 3D-AIR is used in the lithosphere material.

The novelty of this research lies in the 3D-AIR learning media, developed from three-dimensional media with augmented reality, based on Android games, focusing on the lithosphere. Apart from that, this media is limited to the lithosphere material used by class X students using barcodes and three-dimensional images. Augmented reality (AR) technology combines two-dimensional and three-dimensional virtual objects with a real environment, projecting them in real-time (Cheng et al., 2024; Triono et al., 2024; Ubale, 2024). The advantages of augmented reality-based media are: 1) it makes it easier for students to understand abstract concepts into concrete ones, 2) it makes it easier for students to visualize the material given by the teacher, 3) it makes it easier for students to learn independently using Android devices, and 4) it is easy to use without the help of other devices such as laptops/computers or LCDs. Several studies using AR state that students are more interested in understanding the material being taught and in creating an interactive learning atmosphere (Nigam & Saravanan, 2022; Shkilev et al., 2024; Souropetis & Kyza, 2025). The 3D-AIR media can fill a gap in innovative geography learning for high school students. It facilitates students' understanding of the lithosphere through three-dimensional images that approximate real-life situations.

The implementation of 3D-AIR media is expected to optimize students' geography quality at SMA Negeri 8 Banjarmasin, particularly in understanding the lithosphere. This is supported by the use of technology through learning media that provide an interactive, engaging, and personalized learning experience tailored to students' individual needs (Inthanon & Wised, 2024; Taşkın, 2025), so that it can increase student involvement, understanding, interest, motivation, and student learning outcomes (Bawamenewi & Riana, 2024; Sari et al., 2024; Teresa et al., 2023; Wahyudi et al., 2023). Through related research, this effort can directly facilitate educational advancement in the rapidly evolving digital era. Because education serves as a fundamental

component that must align with contemporary developments, it is essential to develop an adaptable framework for classroom instruction. This framework should incorporate presentations that better resonate with today's students' characteristics.

Therefore, based on the analysis of students' needs and characteristics, it is hoped that with the application of 3D-AIR media, students will achieve a comprehensive understanding of geographic concepts, especially those related to the lithosphere, more easily, especially in visualizing the lithosphere later with the help of 3D learning media, which will then be used in educational contexts, so that it serves as a basis for addressing future challenges related to the lithosphere in the future. Therefore, this study aims to measure differences in geography learning outcomes using 3D-AIR media in Android games among students of SMA Negeri 8 Banjarmasin.

2. Method

The method employed was quantitative, with a quasi-experimental research design. The improvement in student learning outcomes through 3D-AIR media was analyzed using a nonequivalent pretest-posttest control-group design, as shown in Table 1. This design employs two groups, the experimental and control groups, which are purpose-assigned. The experimental group received treatment with 3D-AIR media, while the control group received none. Both groups were given a pretest and a posttest as research instruments. The type of questions used is 20 multiple-choice questions.

Table 1. Research Design

Group	Pretest	Treatment	Posttest
Experiment	O1	X	O2
Control	O1	-	O3

This research was conducted at SMA Negeri 8 Banjarmasin, South Kalimantan. The sample for this research consisted of students in grades X.5 and X.6 in the 2024/2025 academic year. The two classes consisted of an experimental group (X.5) and a control group (X.6). These two classes were chosen because of the homogeneity of students and low geography learning outcomes. Both groups were given a pretest to assess the material's homogeneity and their understanding of it. Both groups received separate instructions: the experimental group used 3D-AIR media, and the control group received no treatment. After the treatment, both groups were given a posttest to measure the effectiveness of the media in improving geography learning outcomes. The material taught in this study was the lithosphere in the odd semester of the 2024/2025 academic year.

To determine the effectiveness of 3D-AIR media in optimizing student activities and the quality of geography learning in the technology era at SMA Negeri 8 Banjarmasin, the Mann-Whitney test, previously used for normality and homogeneity tests, was used. The Kolmogorov-Smirnov test determines whether the data distribution is normal based on the Sig. value > 0.05 . The Levene test is used as a homogeneity test with a Sig. value > 0.05 , indicating homogeneous data. The data analysis in this study used the Mann-Whitney test, with the decision-making criterion that if the Sig. value (2-tailed) > 0.05 then H_0 is accepted. The hypotheses of this study include:

H_0 : There is no difference in geography learning outcomes through the application of 3D-AIR media for students at SMA Negeri 8 Banjarmasin.

H_1 : There is a difference in geography learning outcomes through the application of 3D-AIR media for students at SMA Negeri 8 Banjarmasin.

3. Results and Discussion

A. Normality Test

The use of the Shapiro-Wilk test to determine whether the data is normally distributed with a

significance level above 0.05 (Table 2). Based on Table 1, the posttest value distribution was <0.05 , indicating that the data were not normally distributed.

Table 2. Results of the normality test

Class		Kolmogorov-Smirnova			Shapiro-Wilk		
		Statistics	df	Sig.	Statistics	df	Sig.
Results	Pretest (Control)	0.115	30	.200*	0.969	30	0.503
	Posttest (Control)	0.218	30	0.001	0.741	30	0.000
	Pretest (Experiment)	0.136	28	0.196	0.949	28	0.186
	Posttest (Experiment)	0.237	28	0.000	0.912	28	0.022

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

B. Homogeneity Test

In the homogeneity test of the experimental class posttest results (Table 3), it was found that the Sig. The value was $0.094 > 0.05$, indicating the data are homogeneous.

Table 3. Results of the homogeneity test

		Lavene Statistics	df1	df2	Sig.
Posttest	Based on Mean	2,910	1	56	.094
	Based on Median	2,763	1	56	.102
	Based on Median and with adjustment of	2,763	1	38,297	.105
	Based on trimmed mean	2,341	1	56	.132

C. Difference of two means (Mann-Whitney test)

Based on the normality and homogeneity tests, the data distribution was found to be nonnormal and nonhomogeneous, so to test the research hypothesis, the Mann-Whitney test was used. The results of the Mann-Whitney test comparing the experimental and control classes are shown in Table 3. It was found that the Asymp. Sig. (2-tailed) value was $0.861 > 0.05$, meaning that H_0 was accepted. It can be concluded that there was no difference in geography learning outcomes when 3D-AIR media were applied to students at SMA Negeri 8 Banjarmasin.

Table 4. Mann-Whitney test results

	Results
Mann-Whitney University	409,000
Wilcoxon W	874,000
Z	-.175
Asymp. Sig. (2-tailed)	.861

a. Grouping Variable: Class

Learning outcomes are abilities acquired by students through learning experiences, as evidenced by changes in their behavior or conduct, encompassing cognitive, affective, and psychomotor skills (Anni, 2014; Faizah, 2020). These learning outcomes reflect students' learning efforts through the learning process they follow. The more effort students put into their learning, the better their learning outcomes. Therefore, learning outcomes can serve as a benchmark for

measuring the success of classroom learning (Hadiastuti et al., 2024).

The use of learning resources and media has become a crucial component of the classroom learning process in the technology era. The use of interactive learning media is one of the tools educators use to facilitate student understanding, make the material more engaging, increase student motivation, and achieve learning objectives (Festiyed et al., 2023; Mayarisa, 2023). One of the geography learning media used is the 3D-AIR media (3D media - Adventure of Lithosphere) (Figure 1).



Figure 1. 3D-AIR Media Barcode

3D-AIR media is a three-dimensional geography learning media containing lithosphere material in class X. This media uses a visual and interactive approach to improve understanding of lithosphere concepts, including tectonism (figure 2), volcanism (figure 3), and seismicity (figure 4) through clear images in the form of barcodes. This is supported by the statement that 3D-based learning media, such as Cabri 3D, can improve conceptual understanding because they enable the interactive visualization of geometric objects in three-dimensional space (Hendriana, 2019). Previous research also stated that learning media can improve the quality of learning, such as 3D SketchUp, which can improve understanding and skills (Ziqri, 2024), 3D cartoons can improve learning outcomes (Putra, 2021), assemblers edu can increase students' focus, interactivity, and interest in learning, and virtual reality-based learning media can improve students' understanding of the material (Attalina et al., 2024).



Figure 2. Barcode of Tectonism Material in 3D-AIR Media



Figure 3. Barcode of Volcanic Material in 3D-AIR Media



Figure 4. Seismic Material Barcode in 3D-AIR Media

However, the Mann-Whitney test showed no significant difference between the experimental and control classes in improvement in geography learning outcomes using 3D-AIR media. This is because the N-Gain value increased by only 6.40%, resulting in no significant difference between the control and experimental classes in the use of 3D-AIR media. The absence of an increase in geography learning outcomes using 3D-AIR media may be influenced by internal and external factors during classroom learning. Learning components become a unified system that works together cohesively in inseparable learning activities, encompassing learning objectives, materials, methods, media, teacher quality, and evaluation, to achieve effective learning outcomes (Arifin, 2018; Habsy et al., 2024; Pane & Dasopang, 2017).

This 3D-AIR media serves as a tool to facilitate the explanation of lithosphere material. The advantage of this 3D-AIR media is evident in the presentation of materials equipped with a three-dimensional barcode, which displays objects realistically and allows them to be rotated 360°. Additionally, this 3D-AIR media requires minimal storage and is easy to use. However, this media still has a drawback: 3D-AIR media can only be accessed on Android-based mobile phones. In reality, most students also use iOS or HarmonyOS-based mobile phones. In addition, Wi-Fi network support is required for using 3D-AIR media during geography learning activities. This is supported by the statement that the accessibility of learning media is one of the factors in the effectiveness of learning outcomes in schools (Ainurrifqi, 2024).

Several shortcomings in the 3D-AIR media during its implementation in this experimental class were the subject of research findings and can serve as the main focus for upgrades tailored to existing school conditions. This will enable the optimal use of 3D-AIR media during lithosphere learning activities, thereby enhancing geography learning outcomes. However, in addition to the media used, teachers also need support from appropriate learning methods. This is because, during

the implementation of the 3D-AIR media, teachers used only the lecture method in both the control and experimental classes. The findings from this learning activity should be the primary focus for improving learning quality, such as selecting appropriate learning methods and models integrated with 3D-AIR media. This is supported by the fact that the selection of learning methods and models integrated with appropriate learning media also determines the achievement of student learning outcomes (Arofah et al., 2023; Masdar et al., 2024).

However, beyond the use of 3D-AIR media, there are other reasons why geography learning outcomes are not improved by it. The failure to achieve geography learning outcomes can also be influenced by several external and internal factors (Dewayani et al., 2024). Internal factors are those originating within students, encompassing physiological and psychological aspects such as intelligence, attitudes, talents, interests, and motivation. External factors that influence learning outcomes are grouped into two categories: the social environment, which includes the family environment, school, and surrounding community, and the non-social environment, which encompasses school facilities and infrastructure, learning resources and media, and the time allocated to students. These external factors can also arise from the time of geography learning during the day, the availability of supporting facilities and infrastructure in the school environment, or the condition of students' cellphones, which support the use of 3D-AIR media. The finding that there is no difference in geography learning outcomes through 3D-AIR media is a new finding in research on the application of geography media at the high school level. Therefore, this new finding needs to be followed up with further research into the factors underlying the lack of difference in geography learning outcomes using 3D-AIR media.

Although the results differ from those of previous studies, this study provides new findings that can serve as a basis for further research. This strongly supports the statement that not all interactive media applications improve student learning outcomes. This is because media implementation must be tailored to student characteristics, needs, and the depth of the material being taught. This finding is reinforced by previous research, which suggests that media implementation should consider student characteristics, needs, and the depth of the material being taught to effectively achieve learning objectives. Therefore, further research is needed to identify factors influencing the lack of improvement in geography learning outcomes.

4. Conclusion

The results of the Mann-Whitney test analysis showed that the Asymp. Sig. (2-tailed) value was $0.861 > 0.05$. It means that there was no difference in geography learning outcomes when 3D-AIR media was applied to students at SMA Negeri 8 Banjarmasin. During the implementation of 3D-AIR media, several obstacles were encountered, including accessibility issues (currently limited to Android-based mobile phones), the impact on geography learning time during the day, which affects students' mental well-being, and the less-than-optimal condition of WI-FI facilities. These obstacles may affect the achievement of geography learning outcomes in grade X. However, this still needs further research into the factors that prevent an increase in geography learning outcomes through 3D-AIR media and into ways to improve the quality of geography learning.

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