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The Effect of SrVER Learning Model-Assisted Augmented Reality to Improve Students' Learning Outcomes in Science Topic

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Abstract: Science learning plays an important role in developing students' thinking skills and awareness of the environment. One effort to improve the quality of science learning is by implementing innovative and engaging learning models. This study aims to determine the effect of the SrVER learning model assisted by augmented reality (AR) media on students' science learning outcomes. The SrVER learning model is a learning approach that emphasizes students' visual learning styles. This study employs a quantitative quasi-experimental method with a non-equivalent control group design. The population consists of all eighth-grade students at SMP Negeri 2 Mataram, with a sample of 160 students from four classes. The sampling technique used was purposive sampling. Data were analyzed using ANCOVA after meeting prerequisite tests such as normality and homogeneity. The study shows a difference in the experimental class's average pretest and posttest scores, with an average pretest score of 35.5 and a posttest score of 66.775. The ANCOVA test results obtained a significance value of $0.000 < 0.05$, indicating that Ho is rejected and Ha is accepted. This means the SrVER learning model assisted by augmented reality (AR) significantly affects students' science learning outcomes.

Keywords: Augmented Reality (AR); Learning Outcomes; Science; SrVER Model.

Introduction

Natural Sciences (IPA) is a subject that plays an important role in developing students' abilities in the learning process, covering three competencies: knowledge, attitudes, and skills [1]. The development of students' abilities in the learning process is closely related to the use of teaching methods and models, as well as the role of teachers in determining the appropriate approach and learning model. The role of teachers as facilitators is crucial in enhancing students' cognitive, pedagogical, and psychomotor aspects.

In the cognitive aspect, teachers must create easy learning experiences for students to understand. Teachers should provide clear explanations related to the subject matter from a pedagogical perspective. Meanwhile, in the psychomotor aspect, teachers should be able to motivate students who face challenges related to their learning experiences [2]. This aligns with the statement by [3] that the teacher's role in learning significantly influences students' learning outcomes, particularly in achieving the expected competencies in cognitive, affective, and psychomotor domains.

Learning models are conceptual frameworks that systematically outline procedures for organizing students' learning experiences to achieve the desired learning objectives [4]. These objectives can be achieved if teachers select learning models that align with students' needs. When choosing a learning model to implement in the classroom, teachers must consider several factors, including learning objectives, the nature of the subject matter, the availability of facilities, students' conditions, and the allocated time [5]. Therefore, a teacher's understanding of learning models is crucial before conducting learning activities.

When teachers select an appropriate learning model that meets students' needs, it facilitates students' understanding of the subject matter and positively impacts their learning outcomes. In addition to learning models, learning media plays a vital role in supporting the learning process. Learning media are essential in facilitating the teaching process, helping teachers effectively convey information to students. Selecting the right learning media enhances the effectiveness of learning [6].

Based on the observations and interviews conducted with eighth-grade science teachers at a public school in Mataram, students' learning outcomes in science subjects remain low. This is evident because several students have not yet met the minimum completion criteria (MCC) in science. The teacher stated that students' science learning outcomes are categorized into high, medium, and low levels. 45 students in each class, 50%, scored below the MCC.

The low learning outcomes of students can be influenced by several factors, one of which is the implementation of learning models and the use of learning media. As a key factor in the success of the learning process, educators need to assist students in improving their learning outcomes through learning models that encourage active student participation [7]. However, in the current learning process, students are not actively involved, making the learning process teacher-centered. As a result, many students feel bored and struggle to understand the lesson material, leading to low learning outcomes. At SMP Negeri 2 Mataram, various learning models such as Problem-Based Learning (PBL), Project-Based Learning (PJBL), and inquiry-based learning have been implemented. However,

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low learning outcomes are still observed, particularly in science subjects. Therefore, an innovative learning model that actively engages students and prevents boredom during learning activities is needed to improve student achievement. Teachers at SMP Negeri 2 Mataram have not yet implemented one such innovative learning model, the SrVER learning model.

The SrVER learning model is an innovative approach emphasising students' visual learning styles. This model comprises four stages: Screening, Visualization, Elaboration, and Reflection [8]. Screening refers to the initial assessment of students' abilities. Identifying students' prior knowledge and characteristics aims to determine the specific instructional design that needs to be developed according to their initial capabilities [9]. Visualization in the learning process focuses on the sensory ability (vision) to observe objects directly. Visualization is defined as a learning technique that allows concepts to be perceived through the sense of sight in a tangible manner [10]. Elaboration describes strategies for organizing learning content, following a sequence from simple to complex [11]. Students are expected to analyze the information acquired to develop a deeper understanding of concepts through elaboration activities. Reflection is conducted to assess the effectiveness of the learning process. Reflection is a procedure that teachers can use to examine and improve their teaching practices [12]. The SrVER learning model becomes even more effective when integrated with Augmented Reality (AR) media.

Augmented Reality (AR) is a technology in communication and information that integrates two-dimensional or three-dimensional virtual objects into the real-world environment [13]. Learning using Augmented Reality media can help students understand lesson materials, concretize abstract concepts, and provide an interactive learning experience [14]. Augmented Reality media enhances students' comprehension by displaying 3D objects, text, images, videos, and audio in real time [15]. According to research findings [16], the use of Augmented Reality learning media significantly impacts students' learning outcomes.

Based on the background of the problem described above, the researcher is interested in conducting a study titled "The Effect of the SrVER Learning Model Assisted by Augmented Reality (AR) Media on Students' Learning Outcomes in Science Subjects for Eighth-Grade Students at SMPN 2 Mataram."

Research Methods

This study employs a quantitative approach with a quasi-experimental research design. The research design used is the non-equivalent control group design, which aims to examine the effect of the independent variable on the dependent variable under uncontrolled conditions.

Table 1. Research Design (Non-Equivalent Control Group Design

Group	Pretest	Treatment	Posttest
Experimental Class	O_1	X	O_2
Control Class	O_3	-	O_4

(Source: [17])

Explanation:

O_1 : Experimental class before receiving treatment
O_2 : Experimental class after receiving treatment
X : Implementation of the SrVER learning model assisted by Augmented Reality (AR) media
O_3 : Control class after receiving treatment
O_4 : Control class after receiving treatment

This study was conducted at SMP Negeri 2 Mataram. The population in this study consisted of eighth-grade students, totalling 11 classes, with a sample of four classes (VIII A, B, C, and D), each consisting of 40 students. The sampling technique used was purposive sampling.

The research process began by administering a pretest to the control and experimental classes, consisting of 25 questions tested for validity and reliability. The experimental class received treatment in the form of the SrVER learning model assisted by Augmented Reality (AR) media, while the control class did not receive this treatment. After the intervention, a posttest was given to measure students' cognitive learning outcomes following the treatment.

The data obtained from the pretest and posttest were analyzed using IBM SPSS Statistics 23. Before hypothesis testing, prerequisite tests were conducted, including normality and homogeneity tests. Once the data met the assumptions of normality and homogeneity, hypothesis testing was carried out using ANCOVA (Analysis of Covariance). The decision-making criteria for this test were as follows: If sig. (2-tailed) > 0.05, then Ho is accepted, and Ha is rejected. If sig. (2-tailed) < 0.05, then Ho is rejected, and Ha is accepted.

Results and Discussion

The science learning outcomes data obtained from the pretest and posttest in the experimental and control classes are shown in Table 2. below:

Table 2. Pretest and Posttest Scores

	Control Class		Experimental Class	
	Pretest	Posttest	Pretest	Posttest
Highest Score	76	84	76	92
Lowest Score	8	32	8	52
Average Score	37.35	52.775	35.5	66.775

Based on Table 2, the results indicate that the mean scores of students' pretest and posttest in the experimental and control classes show a significant difference in improvement. The experimental class had an average pretest score of 35.5 and a posttest score of 66.775, whereas the control class had an average pretest score of 37.35 and a posttest score of 52.775. The experimental class experienced an increase of 31.28 points, while the control class had an increase of 15.23 points. Based on these findings, it can be concluded that the improvement in students' learning outcomes was greater in the experimental class compared to the control class.

Before conducting the ANCOVA test, the data must undergo prerequisite analysis tests, specifically normality

and homogeneity tests, using IBM SPSS 23.00. The normality test was conducted on the pretest and posttest data for the experimental and control classes to determine whether the data distribution was normal. Since the sample size exceeded 100 students, the Kolmogorov-Smirnov normality test was used. The data is normally distributed if the significance value (Sig.) exceeds (0.05).

Table 3. Normality Test Results

	Class	Kolmogorov-Smirnov[a]		
		Statistic	df	Sig.
Science Learning Outcomes	Pretest (Control Class)	.059	80	.200*
	Posttest (Control Class)	.088	80	.190
	Pretest (Experimental Class)	.048	80	.200*
	Posttest (Experimental Class)	.090	80	.164

Based on the data above, the normality test results for the pretest and posttest in both the experimental and control classes show Sig. values > 0.05, indicating that all data are normally distributed.

The homogeneity test was conducted to determine whether the two analysed sample groups had the same or homogeneous variance. The homogeneity test was carried out using the F-test. The decision rule for the homogeneity test is as follows: The data are considered homogeneous if the significance value (Sig.) > 0.05. The data are not homogeneous if the significance value (Sig.) < 0.05.

Table 4. Homogeneity Test Results

ene Statistic			df1	df2	Sig.
Science Learning Outcomes	Based on Mean	.327	1	158	.568

Based on the table above, the significance value (Sig.) obtained is 0.568 > 0.05, indicating that the posttest data in both the experimental and control classes have a homogeneous variance.

Since the data are confirmed to be normally distributed and homogeneous, a hypothesis test was conducted using the ANCOVA test with the help of IBM SPSS 23. This test was performed to determine the effect of using the SrVER learning model assisted by Augmented Reality media on students' science learning outcomes.The results of the ANCOVA test are presented in the following table:

Table 5. ANCOVA Test Results

Source	Mean Square	F	Sig.	Description
Corrected Model	6952.850	58.57	.000	H_a Accepted

Based on the table above, the significance value for the pretest and posttest data is less than 0.05 ($p < 0.05$), which means that H0 is rejected and Ha is accepted. This indicates that the SrVER learning model assisted by augmented reality (AR) significantly affects the science learning outcomes of eighth-grade students at SMPN 2 Mataram.

The hypothesis test results in this study confirm that the SrVER learning model assisted by augmented reality significantly impacts students' science learning outcomes, as evidenced by a significance value of 0.000 < 0.05. Using the SrVER model with AR media in science lessons helps students understand abstract concepts like the digestive system. Implementing learning activities using the SrVER model allows students to actively search for and gather information with the help of AR media. Such activities make learning more engaging and interactive, encouraging students to be more actively involved, ultimately enhancing their learning outcomes. This learning model consists of four phases: Screening, Visualization, Elaboration, and Reflection. The successful execution of each phase plays a crucial role in achieving the desired learning objectives.

The first phase, Screening, involves students answering basic questions through the website Mentimeter.com to assess their prior knowledge about the digestive system. The existing knowledge that students possess greatly influences the learning process. If students have good prior knowledge, it becomes easier for both teachers and students to interact, facilitating the delivery of learning materials and ultimately impacting student learning outcomes. Prior knowledge plays a crucial role in the learning process and affects learning achievement [18].

The second phase, Visualization, involves the teacher presenting the digestive system material using augmented reality media. A marker is scanned through the Assembler Edu application, allowing students to view a 3D model of the human digestive organs. The use of 3D visualizations in learning enhances students' understanding and retention of the material, which positively affects their learning outcomes. Based on student response surveys, it was found that learning with AR media makes lessons more enjoyable and helps students better understand the digestive organs, which in turn improves their learning results. As seen in Table 2, the posttest scores in the experimental class are higher than those in the control class. This finding aligns with research by [19], which states that learning with visualization techniques can improve student learning outcomes. Additionally, visualization activities in learning can also increase student interest and engagement [20].

The third phase, Elaboration, is where group discussions occur. This activity begins with forming heterogeneous student groups based on their prior knowledge, which was assessed during the Screening phase. Students are then asked to solve several questions related to the digestive system in the Student Worksheet (LKPD). The group discussion aims to encourage students to express their ideas and opinions, fostering collaboration among students in solving problems. Group discussions motivate students to think critically and explore in-depth information, enhancing their reasoning abilities. This is evident from students' enthusiasm in presenting their arguments and their skills in gathering and summarizing information during the discussion. This aligns with the findings of [21], which state that group discussions in the learning process effectively sharpen students' critical thinking skills in problem-solving. Furthermore, a learning approach prioritizes elaboration to

help expand students' understanding and develop higher-order thinking skills [22].

The final stage of the SrVER learning model is Reflection. In this stage, students are asked to review the learning activities they have undergone by summarizing the lesson material in words or sentences. This reflection activity is conducted to identify aspects that need improvement for a better learning experience. Reflection in learning helps students recall the material they have studied and enhances their learning motivation [23].

The SrVER learning model is a student-centered approach based on students' visual learning styles. This model allows students to engage actively in every learning process stage. Student engagement in learning activities can enhance their academic achievement [24]. The systematic stages of this model assist students in gaining a better understanding of abstract concepts, such as those found in science subjects. Additionally, this model incorporates engaging and interactive learning media within its learning syntax, offering a unique learning experience compared to other models. Students engaged and interested in the learning process find it easier to comprehend the material presented, leading to improved academic performance [25].

Augmented Reality (AR) media within the SrVER learning model provides a more enjoyable learning experience. AR media can visualize abstract concepts and present learning materials more engagingly, enhancing students' learning outcomes. This aligns with the findings of [26], which state that augmented reality media positively impacts students' learning outcomes and process skills because of its visually appealing features, making it easier for students to understand the lesson material. Furthermore, integrating AR media into learning can boost students' enthusiasm for studying [27].

In contrast, the control class, which applied a conventional learning model, showed a smaller increase in pretest and posttest scores than the experimental class. This is because, in the conventional learning model, students primarily listen to the teacher's explanations, resulting in low engagement and making the learning process less interactive and monotonous. Additionally, students face limited opportunities to seek information independently, which hinders their understanding of the subject matter and ultimately leads to lower learning outcomes. Conventional learning models tend to make students feel bored and disengaged, negatively impacting their academic performance [28].

Conclusion

Based on the research findings, data analysis, and discussion, it can be concluded that the SrVER learning model assisted by Augmented Reality (AR) significantly influences students' science learning outcomes at SMPN 2 Mataram. Students taught using the SrVER model with AR media demonstrated better learning outcomes than those who learned through conventional models and media. This study recommends that teachers implement innovative learning models and media by integrating technology into the learning process. This approach can create a more interactive and student-centered learning environment, ultimately enhancing students' learning outcomes. Further research on the SrVER model is recommended for other subjects, such as chemistry and physics, incorporating additional variables like learning motivation and critical thinking skills.

Author's Contribution

Muslimah Elynati: Designed the learning materials, conducted the research, analyzed the data, and wrote the manuscript. Baiq Sri Handayani & Tri Ayu Lestari: Served as supervisors, providing fundamental research concepts, motivation, and support to encourage the researcher. Jamaluddin: Acted as an instrument validator and examiner.

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