

The Effectiveness of SrVER-Based Learning Modules Integrated with Augmented Reality in Improving Students Health Literacy on the Circulatory System

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Abstract: Biology, as a branch of natural science, plays an important role in providing students with an understanding of humans, the environment, and factors that influence health. This study aimed to determine the effectiveness of Screening, Visualization, Elaboration, and Reflection (SrVER)-based learning modules integrated with Augmented Reality (AR) in improving students' health literacy in circulatory system learning at SMAN 3 Mataram. This study used a quantitative quasi-experimental design with a Non-Equivalent Control Group. The study involved 50 eleventh-grade students of SMAN 3 Mataram in the 2025/2026 academic year who studied the circulatory system material using a purposive sampling technique. Data were collected using multiple-choice questions. The data analyzed in this study were the N-Gain test and the Mann-Whitney test. The results of the prerequisite test showed that the data did not meet the assumptions of normality or homogeneity of variance; therefore, the analysis was conducted using the nonparametric Mann-Whitney U test on the N-gain score. The study found that the experimental class had an N-Gain of 0.8, in the high category, while the control class had an N-Gain of 0.3, in the low category. In addition, the Mann-Whitney test obtained an Asymp. Sig. (2-tailed) value of $0.000 < 0.05$, which means there is a significant difference in the post-test scores of the experimental and control classes. Thus, the null hypothesis (H_0), which states that there is no effectiveness in using the SrVER-based learning module integrated with Augmented Reality (AR), is rejected. In contrast, the alternative hypothesis (H_a) is accepted. It can be said that using the SrVER-based learning module integrated with Augmented Reality (AR) to improve students' health literacy in the circulatory system material at SMAN 3 Mataram is effective.

Keywords: Augmented Reality; Circulatory System; Health Literacy; SrVER Learning Model.

Introduction

Biology, as a branch of natural science, plays a crucial role in helping students understand humans, the environment, and the factors that influence health. By studying biology, students are expected not only to understand concepts and theories but also to apply them in their daily lives, particularly to maintain their own health and that of their environment. Biology learning can also serve to improve health literacy, as topics such as the circulatory system, nutrition, infectious diseases, and healthy lifestyles are closely related to the ability to make health decisions [1].

Health literacy is a person's ability to access, know, understand, and evaluate health information related to decision making, which emphasizes the importance of applying information in daily activities. [2], [3]. A person with higher health literacy will be better able to apply the information they have in their daily life. On the contrary, someone with low health literacy will usually find it more difficult to understand health information. [4]. Therefore, health literacy is very important because it helps build positive skills and attitudes to maintain health.

However, based on initial observations from the distribution of questionnaires at one of the State Senior High Schools in Mataram City in 2025, health literacy was found to be relatively low, as indicated by the average scores across indicators. Students' ability to access health information

(40.2%), understand health information (38.6%), assess health information (39.4%), and apply health information (40.2%). This aligns with previous research, which found low health literacy across all indicators. [5], [6].

This low level of health literacy is thought to be influenced by one-way learning methods, limited media, and suboptimal teaching materials. In line with Wahyuni et al. [7], the opinion is that the lecture method and monotonous media are less effective at increasing students' health literacy. One cause of low health literacy is learning that is not linked to students' daily lives [8].

One alternative is a learning module. A learning module is a form of teaching material that is systematically packaged to facilitate students' learning experiences, achieve learning objectives, and is engaging and easy to study independently [9], [10]. Students can use learning modules according to their abilities, including utilizing time according to their readiness and opportunities with the characteristics they have; this is called self-instructional [11]. According to Anwar [12], systematically designed learning modules integrated with a specific model can facilitate more meaningful and independent learning.

The SrVER learning model can be used in the learning process. SrVER is an acronym for Screening, Visualization, Elaboration, and Reflection, which emphasizes the visual learning style. [13]. This model can help students identify prior knowledge, facilitate conceptual understanding through visual representations, foster

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collaboration between students, and foster student reflection on learning. This learning model can also be integrated with Augmented Reality (AR). AR is a technology that combines the real and virtual worlds directly or in real time. [14], [15].

Although several previous studies have been conducted, such as Maryam et al. [16], who examined the use of the SrVER learning model assisted by Virtual Reality (VR) media on biology learning outcomes, Sanirim et al. [17], who investigated the effect of the SrVER learning model assisted by learning videos on science learning outcomes, and Muliani et al. [18], who analyzed the effect of the SrVER learning model assisted by Augmented Reality on cognitive abilities in biology learning achievement, these studies generally focused on learning outcomes and cognitive aspects. To date, no study has specifically examined the use of SrVER-based learning modules integrated with Augmented Reality to improve health literacy in circulatory system learning. Therefore, this study is important to address this research gap. The novelty of this study lies in the integration of SrVER-based learning modules with Augmented Reality, specifically designed to enhance students' health literacy in circulatory system learning.

Therefore, the implementation of a SrVER-based learning module integrated with AR is expected to improve students' health literacy. This research aims to assess the effectiveness of the module in improving students' health literacy related to the circulatory system.

Research Methods

This study employed a quantitative, quasi-experimental design. It used a non-equivalent control group design involving an experimental group and a control group to examine the effect of an Augmented Reality-integrated SrVER-based learning module on students' health literacy in circulatory system learning. The experimental group received treatment using the Augmented Reality-integrated SrVER-based learning module, while the control group received conventional instruction. This design enabled the researchers to compare changes in students' health literacy based on the pretest and posttest results of both groups.

Table 1. Non-Equivalent Control Group Design

Group	Pre-test	Treatment	Post-test
E	0 ¹	X	0 ²
K	0 ³	-	0 ⁴

[19]

Information:

- E = Experimental group
- K = Control group
- 0₁ = Pretest of the experimental group
- 0₂ = Posttest of experimental group
- X = Experimental method treatment
- = Conventional method treatment
- 0₃ = Pretest of control group
- 0₄ = Posttest of control group

The study was conducted at SMA Negeri 3 Mataram in the 2025/2026 academic year. The study population consisted of all eleventh-grade students enrolled in a circulatory system course. The sample was selected using a

purposive sampling technique based on the biology teacher's recommendation and similarities in academic characteristics between classes. The sample consisted of two classes: one experimental class and one control class, each with 25 students. The treatment was administered over three meetings.

The research procedure commenced with a pretest administered to the experimental and control groups using 20 multiple-choice questions that had been tested for validity, reliability, difficulty level, and discriminating power. The instrument was developed based on health literacy indicators, which include the ability to access, understand, evaluate, and apply health information. Next, the experimental group received instruction using a SrVER-based module integrated with Augmented Reality, while the control group received conventional instruction. After three sessions, both groups were given a posttest to assess improvements in students' health literacy.

Data obtained from the pretest and posttest results were analyzed using IBM SPSS Statistics. Before conducting hypothesis testing, assumption tests were conducted, including normality and homogeneity tests. If the data met the assumptions of normality and homogeneity, a one-way ANCOVA was conducted with pretest scores as a covariate to control for differences in students' initial abilities. However, if the data did not meet these assumptions, the analysis was performed using the nonparametric Mann-Whitney U test, with N-gain scores, to determine differences in health literacy improvement between the experimental and control groups.

This research was conducted after obtaining official approval from the school administration and the biology teacher. Participants were informed of the research objectives prior to the study, and their information was kept confidential and used solely for academic purposes.

Results and Discussion

The pre-test and post-test results for students in the experimental and control classes showed differences, as indicated by N-gain calculations (Table 2).

Table 2. Pre-test and Post-test Results

Class	Average Value		N-Gain	Infor
	Pre-test	Post-test		
Control Class	43,2	61,2	0,3	Low
Exp Class	43,2	89,8	0,8	High

Based on Table 2, there is a difference in the average pre-test and post-test scores between the control and experimental classes. The average pre-test value in the control class was 43.2, and the average post-test value was 61.2, whereas in the experimental class, the average pre-test value was 43.2 and the average post-test value was 89.9. The N-gain value was then calculated. Then, the N-gain value in the control class was 0.3, which was in the low category, while the N-gain value in the experimental class was 0.8, in the high category, indicating an increase. Before conducting an ANCOVA test, the data are first tested for prerequisites, namely normality and homogeneity. The normality test determines whether the data are normally distributed. Data is considered normally distributed if its significance value is ≥ 0.05.

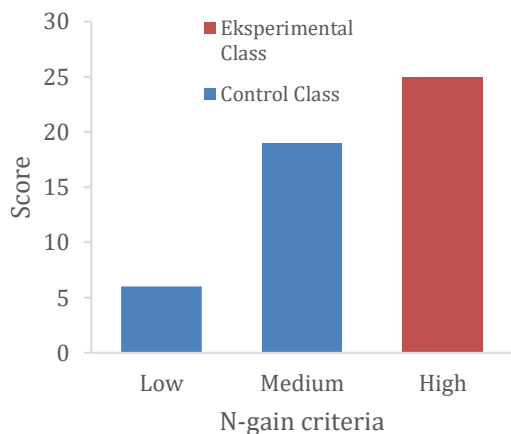


Figure 1. Comparison of N-Gain Scores

Table 3. Normality Test Results

Class	Shapiro-Wilk			Information
	Statistic	Df	Sig	
Exp Pre-test	.922	50	.003	Abnormal
Exp Post-test	.769	50	.000	Abnormal
Control Pre-test	.965	50	.139	Normal
Control Post-test	.913	50	.011	Abnormal

Based on Table 3 above, one sample of data was obtained that was normally distributed, namely the pre-test value data for the control class with a significance value of $0.139 > 0.05$, while in the post-test for the control class and the experimental class, the pre-test and post-test data had a significance value of <0.05 , so that the data was not normally distributed. A homogeneity test was conducted to determine whether the two classes were homogeneous. The calculation results are shown in Table 4.

Table 4. Homogeneity Test Results

	Levene Statistic			
		df1	df2	df3
Based on mean	10.027	1	48	.003

Based on the Levene test results in Table 4.3 above, the p-value of $0.003 < 0.05$ indicates that the data have non-homogeneous variance. Because the data did not meet the assumptions of normality and homogeneity, the hypothesis test was carried out using the nonparametric Mann-Whitney U test on the N-Gain score.

Table 5. Hypothesis Test Results

Mann-Whitney U	.000
Wilcoxon W	325.000
Z	-6.125
Asymp. Sig. (2-tailed)	.000

Based on the results of the Mann-Whitney hypothesis test, it was found that the students' post-test scores obtained an Asymp. Sig. (2-tailed) value of $0.000 < 0.05$. This indicates that H_a is accepted, so it can be said that the SrVER-based learning module integrated with Augmented Reality is effective in improving students' health literacy

regarding the circulatory system material at SMAN 3 Mataram.

The research analysis showed a difference in the improvement in student health literacy between the experimental and control classes, with the experimental class achieving a higher average score. The higher average score in the experimental class was due to the syntax of the SrVER learning model. The syntax of the SrVER learning model, which includes screening, visualization, elaboration, and reflection, supports students in understanding the material in a more in-depth and structured way. The use of Augmented Reality in this learning creates a more interactive experience by enabling direct interaction with learning objects in a three-dimensional environment. The SrVER-based learning module used to support the implementation of the learning activities is presented in the supplementary material, Figure 2.



Figure 2. SrVER-Based Learning Module

The screening stage, the initial stage of learning, aims to measure individual student abilities [20]. At this stage, the researchers used Mentimeter.com's word cloud feature to identify students' prior knowledge of the circulatory system. This activity helped activate students' prior knowledge and encouraged active participation in learning. This aligns with [21], who stated that using Mentimeter can increase student engagement in the learning process. Prior activation contributed to improved students' ability to understand health information, as reflected in increased health literacy in the experimental class.

The visualization stage is used to present information in the form of images, animations, and graphs, thereby facilitating students' understanding Budiman, [22]. In this study, Augmented Reality was used to help students observe three-dimensional representations of the circulatory system more concretely. An example of the Augmented Reality media developed in this study is presented in the supplementary material, Figure 3. This visualization enabled students to understand abstract concepts that are difficult to comprehend through two-dimensional media. This finding is supported by Utami et al. [23], who stated that visualization plays a crucial role in reducing misconceptions about abstract concepts. This improved conceptual understanding enhances students' ability to comprehend health information,

as reflected in higher post-test scores in the experimental class than in the control class.



Figure 3. Augmented Reality Learning Media

The elaboration stage is a collaborative activity in a collaborative activity for solving problems in the student worksheet (LKPD) to train students' communication and collaboration skills Handayani et al., [24]. In this stage, students work together based on observations using Augmented Reality media to answer questions and agree on solutions. This discussion process encourages students to analyze and evaluate health information, helping them develop a more meaningful understanding. This contributes to improved students' health literacy, as evidenced by the significant difference between the experimental and control classes based on the Mann-Whitney test Asymp. Sig. (2-tailed) = 0.000 < 0.05. This finding is supported by Fauzi & Wisanti [25], who stated that collaborative learning-based LKPD is effective in improving students' collaboration.

The elaboration stage, namely collaborative activities in solving problems on worksheets, trains students' communication and collaboration skills [13]. At the beginning of the elaboration stage, the researcher distributed worksheets based on students' observations of AR use. Students had to work together to answer questions, exchange ideas, and agree on solutions in the worksheets. This activity developed students' analytical and evaluation skills, which supported the indicator of assessing health-relevant information. This ability contributed to a significant difference in health literacy between the experimental and control classes, as confirmed by the Mann-Whitney test with an Asymp. Sig. (2-tailed) value of 0.000 < 0.05.

The reflection stage is where students reflect on the learning process to practice their reflective skills, enabling them to recognize what they have learned and its benefits in their daily lives Handayani et al., [13]. At this stage, students evaluate their learning experiences and connect the material to real-life situations. This reflection activity helps students develop a more meaningful understanding and increases their awareness of the application of health information in everyday life. This is supported by Sakung et al. [26], who stated that reflection activities help students evaluate their learning experiences and develop more effective learning strategies. Thus, the reflection stage not only improves conceptual understanding but also shapes students' health awareness and behaviors. This impact is reflected in improved students' health literacy in the experimental class. Documentation of the implementation of the SrVER learning

activities in the classroom is provided in the supplementary material (Figure 4).



Figure 4. SrVER Learning Activities in the Classroom

In addition to learning models, engaging media such as Augmented Reality also play a crucial role in learning activities. Using Augmented Reality in the learning process can make abstract ideas more tangible and easier for students to understand. This is in accordance with the opinion of Pebriyani et al [27] that AR-based learning media are able to improve students' understanding of anatomy material because of their interactive and realistic visualization.

The success of the SrVER model, supported by Augmented Reality, in improving students' health literacy has implications for future curriculum development and teaching approaches. The application of technology in education, particularly Augmented Reality, is expected to be increasingly used across subjects, not just Biology, to improve the overall quality of learning.

Overall, the results of this study show a significant difference between the control and experimental classes, indicating that the SrVER model, supported by Augmented Reality media, can improve students' health literacy in the circulatory system material. This research opens up further opportunities to explore the potential of technology in education and to strengthen its role in supporting more innovative and effective learning processes across various fields of study.

This study has several limitations. It involved only two classes from one school, so the findings cannot be generalized to a wider population. Furthermore, the use of a quasi-experimental design meant the researchers could not fully control for all external variables that could influence students' health literacy, learning environment, and differences in prior knowledge. Another limitation is the use of Augmented Reality media, which requires specific technological devices and facilities, making its implementation dependent on the availability of school infrastructure.

Implementing Augmented Reality-based learning also faces several challenges. Not all schools have adequate technological facilities, such as smartphones or computers that support AR applications. Limited internet access can also be a barrier to implementing technology-based learning. Furthermore, teachers need adequate skills and preparation

to integrate Augmented Reality into the learning process to enable effective classroom implementation.

Conclusion

Based on the research results, it can be concluded that the SrVER-based learning model integrated with Augmented Reality is effective in improving students' health literacy in circulatory system material. This is evidenced by a significance value of $0.000 < 0.05$, indicating a significant difference between the experimental and control classes. The SrVER learning model, assisted by Augmented Reality, has proven more effective than conventional learning, as demonstrated by improvements in students' health literacy in the experimental class.

Author's Contribution

N.A. Putri: Compiling learning materials, conducting research, processing data, and writing this research. B.S. Handayani and M.R. Adawiyah: acting as a conceptual basic guide, providing encouragement, motivation, and support to researchers. T.A. Lestari: acts as an examiner.

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