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The Effectiveness of SrVER-Based Learning Modules Integrated with Augmented Reality on Students Self-Efficacy in Excretory System Topics

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Abstract: Biology learning requires students to have self-efficacy, namely, confidence in their abilities to solve learning problems and complete certain tasks. SrVER is a learning model that emphasizes a visual learning style, which adapts the main principles in the teaching and learning process, namely Screening, Visualization, Elaboration, and Reflection. The SrVER model can be considered one approach with the potential to improve student self-efficacy. The purpose of this study was to determine the effectiveness of SrVER-based learning modules integrated with Augmented Reality (AR) on student self-efficacy in excretory system material at SMAN 2 Mataram. This study used a quantitative experimental method with a non-equivalent control group design and purposive sampling. The experimental group was given treatment, namely the use of the AR-integrated SrVER learning module, while the control class, the learning was as usual for teachers. Data collection in this study was carried out by distributing questionnaires to students, totaling 28 questions. Data were analyzed using the Mann–Whitney U test because the data were not normally distributed. The results of the study obtained an Asymp. Sig. (2-tailed) value of 0.003, which indicates that the value is <0.05, so that Ha is accepted and Ho is rejected, so that it can be interpreted that there is an effectiveness of the use of the SrVER learning module integrated with augmented reality on student self-ability in the excretory system material for class XI of SMAN 2 Mataram. These findings indicate that integrating SrVER and AR can support more interactive and meaningful biology learning.

Keywords: Augmented Reality; Self-efficacy; SrVER Learning Model.

Introduction

Biology is one of the most difficult subjects to learn in school [1]. Biology learning requires students' self-confidence in answering and solving biological problems encountered in the learning process [2]. This self-confidence is known as self-efficacy, the belief or confidence an individual has in his or her ability to carry out a particular task. The aspects that form self-efficacy are level (the difficulty of the task), generality (the breadth of the field), and strength (the strength of the belief) [3]. This individual belief or steadfastness determines whether a person will think optimistically or pessimistically, motivate themselves to persist in the face of difficulties, regulate emotional conditions, and make decisions that shape the direction of their life [4]. People who have low self-efficacy will rarely succeed in their tasks because their ability to mobilize motivation and all the resources they have (smarts, mobilizing colleagues to help) is not optimal [5]. Students with high self-efficacy are confident, assertive, and willing to take risks in the learning process to achieve learning goals. They are confident in tackling more difficult tasks and in the results of their work. In contrast to students who have low self-efficacy, they are afraid to do assignments because they are not confident in the results of their work, which gives rise to the desire to copy their friends' work [6], so self-efficacy is very important, and this aspect must be possessed by students.

Based on a preliminary study conducted in 2025 at a high school in Mataram City, interviews with biology teachers revealed that some students still showed low self-efficacy, especially in their confidence in completing assignments independently. The teacher said that some students tend to find it difficult and lack confidence when they have to understand the material on their own, so they prefer to study in groups to help each other. Students stated that the most common methods used by teachers at school were lectures and note-taking, so most were confused when the teacher explained in class. The questionnaire results showed that student self-efficacy was in the moderate range, at 55.23%. This is an important concern, as low self-efficacy can lead to students' lack of confidence in their ability to understand complex material.

Similar conditions were also found in the research of SMA Negeri 1 Indralaya Utara and SMA IT Raudhutul Ulum, which had self-efficacy levels in the medium category (63.3%) [7]. In addition, the research of [8] stated that the students of class X SMA Negeri 8 Medan showed a mostly medium level of self-efficacy, with 11.0% (low), 71.9% (medium), and 17.1% (high). Students at SDN 10 Puhun Pintu Kabun Panganak, Bukittinggi City, had low self-efficacy, which caused students to be lazy to complete the tasks given by the teacher, and there were students who only wanted to complete what they believed could be completed, rather than those they did not believe in and did not complete [9].

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The low self-efficacy of students in biology learning at the school is caused by the model used, which is not fully effective in building students' confidence in understanding the material. This problem affects student self-efficacy. The level of student self-efficacy in one school in Mataram City is high in only some classes, not evenly distributed across all classes, because student interest and confidence in learning are low. The learning models applied are Problem-Based Learning (PBL) and Project-Based Learning (PjBL). PBL and PjBL require students to solve problems and create project products, but in practice, not all students feel confident tackling complex tasks, especially when learning is not supported by media. This causes student self-efficacy not to develop evenly across all classes. The teaching materials used by teachers there are limited to textbooks and learning videos.

Self-efficacy can be improved by improving the quality of the learning process [10]. One way is by choosing the right learning materials. The learning materials can be delivered as modules. Learning modules are independent learning packages systematically arranged to facilitate students' learning experiences and achieve learning objectives. By using effective modules, learning can reach students, including those with diverse characteristics. Students can use learning modules according to their abilities, including utilizing time according to their readiness and opportunities [11]. Learning modules, as an innovative learning resource, play an important role in improving student self-efficacy [10]. Modules in the teaching and learning process have advantages in terms of increasing student motivation and independence, which also influence student self-efficacy [6]. The use of appropriate learning modules can improve students' self-efficacy.

An appropriate learning model can also improve student self-efficacy [12]. The learning model is an important component of learning because it effectively supports the learning process, making it easier to achieve learning objectives. Variations in learning models can provide student enthusiasm for learning, avoid boredom, and have implications for student interest and motivation in following the learning process [13]. One model that can be used is the SrVER learning model. The SrVER learning model is an approach that emphasizes visual learning styles, which adapts the main principles in the teaching and learning process, namely Screening, Visualization, Elaboration, and Reflection [14]. The SrVER model can be considered one approach with the potential to improve student self-efficacy. The combination of learning modules and the SrVER model makes learning more interesting and enjoyable, and easier for students to understand concepts.

The use of learning media is no less important in the teaching and learning process; it can develop new interests and desires, stimulate motivation, and even have a psychological impact on learning [15]. The use of special learning media to overcome low self-efficacy is an innovative step and supports the development of their learning independence [16]. Interesting learning media are needed to increase student self-efficacy. Biological concepts really need significant and interesting explanatory media to encourage students to study biology comprehensively and in depth [17]. In this regard, learning innovations are needed in the form of learning media that create an engaging, interactive learning experience.

One of the potential media used to achieve these goals is Augmented Reality (AR) based learning media, because it allows students to learn directly through immersive visual experiences [18]. The use of AR learning media is very useful in improving the learning process and student interest because AR has entertainment aspects that can increase student interest in learning and playing, and project it in a real way and involve the interaction of all five senses [19]. AR is well-suited to the current digital era compared to media that display only one-dimensional images. AR-based learning media to increase student self-efficacy is declared valid or feasible with a percentage of 93% [17]. AR is a technology that combines three-dimensional virtual objects into the real world in real-time, so that students can interact more interestingly with learning materials [20]. The integration of SrVER with AR is expected to increase student motivation and confidence in understanding complex excretory system material.

Several previous studies [21], [22] showed that the implementation of the SrVER learning model integrated with Augmented Reality (AR) was effective in improving students' biology learning outcomes in various materials, such as the digestive system and viruses. However, no research has specifically investigated the implementation of SrVER-based learning modules integrated with Augmented Reality to improve students' self-efficacy in learning about the excretory system. Therefore, this study aims to fill this research gap by examining the effectiveness of SrVER-based learning modules integrated with Augmented Reality in improving students' self-efficacy.

Research Methods

This study uses a quantitative experimental research design, with the independent variable the application of the AR-integrated SrVER learning module in the experimental and control classes, and the dependent variable student self-efficacy. The sampling technique in this study used purposive sampling [23] with a non-equivalent control group design. The experimental group was given treatment, namely the use of the AR-integrated SrVER learning module, while the control class received learning as the teacher usually does. In the experimental class, students used smartphones to scan AR markers available in the learning module, which displayed three-dimensional visualizations of the excretory system organs. The AR integration was mainly applied during the visualization stage to help students understand abstract biological concepts more concretely and interactively.

The study involved 70 students consisting of 35 students in the experimental class and 35 students in the control class. The AR-integrated SrVER learning module was implemented across four learning sessions on excretory system material. Before the study was implemented, permission to conduct the research was obtained from the school. In addition, students participated in the study voluntarily after being informed about the research procedures. The research design (Non-equivalent control group) is shown in Table 1.

The instrument used in this study was a self-efficacy questionnaire. Prior to data collection, the instrument was tested for validity and reliability to ensure its accuracy and consistency in measuring students' self-efficacy [25]. The

validity test results indicated that all 28 questionnaire items were valid, while the reliability test showed a Cronbach's Alpha value of 0.819, indicating that the instrument was reliable. The questionnaire consisted of 28 items based on the aspects of self-efficacy, namely level (level of task difficulty), generality (breadth of field), [26] and strength (level of belief strength), [26], using a Likert scale of 1-4, namely 1 = Disagree, 2 = Somewhat Agree, 3 = Almost Agree, and 4 = Strongly Agree [27]. Students' self-efficacy data were obtained from the pretest and posttest questionnaire results.

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

Group	Pretest	Treatment	Posttest
Experimental Class	0_1	X	0_2
Control Class	0_3	-	0_4

(Source: [24])

Explanation:
0_1 = Experimental class before receiving treatment
0_2 = Experimental class after receiving treatment
X = Implementation of SrVER-based learning modules integrated with Augmented Reality (AR) media
0_3 = Control class before receiving treatment
0_4 = Control class after receiving treatment

After the pretest, treatment, and posttest were administered, the data obtained were then analyzed using the ANCOVA (Analysis of Covariance) hypothesis test to determine whether there was a significant difference in self-efficacy between the experimental group and the control group. The ANCOVA test is used when the data are normally distributed and have homogeneous variance. Therefore, before conducting the ANCOVA test, prerequisite tests are carried out, including normality and homogeneity tests. If the data are not normally distributed or homogeneous, a nonparametric test, namely the Mann-Whitney U test, will be used. Decision making in the ANCOVA and Mann-Whitney U tests is based on the significance value (sig.). If sig. ≤ 0.05, then H_0 is rejected, whereas if sig. > 0.05, H_0 = accepted.

Results and Discussion

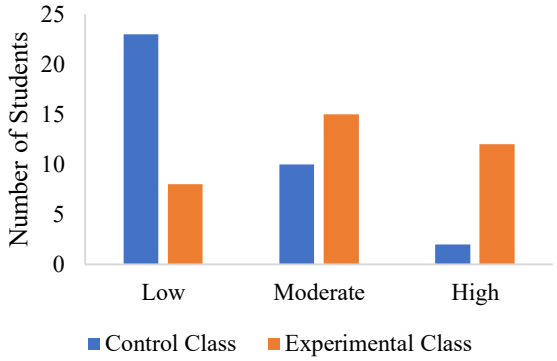
The results of students' self-efficacy in the control and experimental classes, as measured by the pretest and posttest, showed a difference in improvement between the two classes.

Table 2. Pre-test and Post-test Results of Control and Experimental Classes

Kelas	Average Score		N-Gain	Information
	Pretest	Postest		
Control	75.84	85.21	0.28	Low
Experimental	79.25	96.44	0.57	Moderate

Based on Table 2, scores increased from pretest to posttest after learning. In the control class, the average pretest score was 75.84 and increased to 85.21 in the posttest, while in the experimental class, the average pretest score was 79.25 and increased to 96.44 in the posttest. The N-Gain value was then calculated, and an increase in student self-efficacy was observed in the control class (0.28), categorised as low, while in the experimental class, an N-Gain value of 0.57 was observed, categorised as medium. The N-Gain results indicate that the increase in student self-efficacy in the experimental class was higher than in the control class. To provide a more detailed overview, the distribution of students' self-efficacy enhancement based on these N-gain categories is visualized in Figure 1.

Figure 1. Distribution of students' N-gain categories in the control and experimental classes.



As shown in Figure 1, the control class was heavily dominated by students in the low category (23 students). Conversely, the experimental class demonstrated a substantial shift, where 15 students achieved a moderate enhancement and 12 students reached the high category.

Before conducting the hypothesis test, prerequisite tests were conducted, namely the normality test and the homogeneity test [25]. Data were considered normal if the significance value (sig.) was > 0.05, while data were considered abnormal if the significance value (sig.) was ≤ 0.05.

Table 3. Normality Test Results

Class	Shapiro-Wilk			Information
	Statistic	df	Sig.	
Pretest (Control Class)	.953	35	.135	Normal
Posttest (Control Class)	.976	35	.616	Normal
Pretest (Experimental Class)	.961	35	.244	Normal
Posttest (Experimental Class)	.937	35	.046	Non-normal

Based on Table 3, the results of the normality test show that the pretest and posttest scores in the control class have significance values of 0.135 and 0.616, respectively, indicating a normal distribution. The pretest data for the experimental class also showed a significance value of 0.244, indicating a normal distribution. However, the posttest data for the experimental class yielded a significance value of 0.046, which is <0.05 and suggests a non-normal distribution.

Another requirement, the homogeneity test, is used to determine whether the research samples have the same variance. Data is considered homogeneous if the significance (sig.) is > 0.05, and if (sig.) is ≤ 0.05, it is not homogeneous. The results of the homogeneity test are shown in Table 4 below.

Table 4. Homogeneity Test Results

	Levene Statistic	df1	df2	Sig.	Information
Based on Mean	.840	1	68	.363	Homogeneous

Based on Table 4, a significance value of 0.363 was obtained, which is greater than 0.05, indicating that the self-efficacy post-test data in the control and experimental classes are homogeneous. The hypothesis test in this study used the non-parametric Mann-Whitney U test because the results were not normally distributed. The Mann-Whitney U test was conducted by calculating the difference between the pretest and posttest scores.

Table 5. Hypothesis Test Results

Mann-Whitney U	356.500
Wilcoxon W	986.500
Z	-3.009
Asymp. Sig. (2-tailed)	.003

The results of the Mann-Whitney hypothesis test obtained an Asymp. Sig. (2-tailed) value of 0.003, which indicates that the value is <0.05, so that Ha is accepted and Ho is rejected, so it can be interpreted that there is an effectiveness of using the SrVER learning module integrated with augmented reality on students' self-efficacy in the excretory system material for class XI of SMAN 2 Mataram.

The data analysis showed a difference in the increase in student self-efficacy between the experimental and control classes, with the experimental class achieving a higher average score. The high average score in the experimental class was due to the syntax in the SrVER learning model, which was shown to increase students' average scores. This was shown by several previous research results. This study showed that learning designed by implementing modules, supported by an appropriate learning model, namely the SrVER model and interactive visual media AR, effectively increased self-efficacy in understanding the material and completing assignments. These results are in accordance with [28], who said that learning media can help increase students' self-efficacy, such as interactive learning media based on Augmented Reality.

The increase in self-efficacy in the experimental class is related to the SrVER model's characteristics. Several stages in the SrVER learning model consist of the Screening, Visualization, Elaboration, and Reflection stages. The Screening stage is important in building students' initial readiness before entering learning. The teacher will identify students' prior knowledge related to the material, and provide appropriate learning, so that there is no gap between prior knowledge and the new knowledge provided [29]. This is in line with research, prior knowledge is important in learning, this is because learning becomes easier for students, so that learning objectives can be achieved [30]. At this stage, students are directed to answer questions about prior knowledge of the material on the Mentimeter media. This stage makes students more confident that the material to be learned is still within their ability range. This initial belief contributes to an increase in students' self-efficacy, especially in the level aspect, namely, students' confidence in facing the level of difficulty of learning tasks. This increase is evident in the study's results, which show higher students' self-efficacy scores.

The visualization stage is the most effective stage in increasing student self-efficacy due to its ability to transform abstract excretory system concepts into realistic three-dimensional visual representations. Visualization is a method used to concretely convey abstract concepts so that they can be better understood [31]. During the learning process, this effectiveness was clearly evident in the enthusiasm and active responses of students who felt helped in understanding anatomical structures that were previously difficult to visualize. This is in line, visualization acts as a tool that facilitates understanding and exploring data quickly [32]. The use of AR media at this stage provides a concrete learning experience, so that students' doubts when faced with complex material are replaced with strong self-confidence. The visualization stage is very helpful in increasing self-efficacy by strengthening students' confidence in understanding real visualizations, thereby creating a moment of direct learning success (mastery experience). This improvement is marked by an increase in the experimental class's average score from 79.25 to 96.44. The documentation of students utilizing the module and the sample visualization of the developed Augmented Reality media are presented in Figure 2 and Figure 3, respectively.

Figure 2. Students using AR-integrated learning modules during excretory system learning.

Figure 3. Example of the AR-integrated SrVER-based learning module and three-dimensional visualization of excretory system organs displayed through Augmented Reality.

The elaboration stage encourages students to be active through problem-solving discussions, while simultaneously building their courage to express opinions and handle challenging tasks. Students solve LKPD problems with the aim of practicing their communication and collaboration skills, finding solutions, and developing

materials with more detailed explanations [22]. This activity helps students realize that they are able to work independently or collaborate with others in completing learning tasks. This experience strengthens students' self-efficacy in the strength aspect, namely perseverance and tenacity in facing learning challenges, and encourages students not to give up easily when facing difficulties. This activity contributes to the difference in self-efficacy between the experimental and control classes, as confirmed by the Mann-Whitney test with an Asymp. Sig. (2-tailed) value of $0.003 < 0.05$.

The reflection stage provides students with space to evaluate their learning process and results, helping them become aware of the progress they have made. Through this stage, students are invited to assess the extent of their understanding and any difficulties they have experienced. Reflection on students' self-efficacy is very important for identifying deficiencies and their causes, so that corrective steps can be taken [33]. This stage plays a very important role in increasing self-efficacy in the general aspect, because students will realize that the abilities they have can not only be used for certain tasks, but can also be applied in various situations and different materials.

The results of this study are supported by students' active and positive responses during the implementation of the AR-integrated SrVER-based learning module. During the learning process, students in the experimental class showed greater enthusiasm in participating in activities and were more confident in understanding the material and completing learning tasks. The SrVER learning model provides structured learning stages, starting from building initial readiness, presenting visualizations, encouraging thinking activities through discussions, and reflecting on learning outcomes. The integration of AR media also helps students understand abstract concepts of the excretory system by presenting realistic visuals, making them easier to understand. This condition indirectly strengthens students' confidence in their ability to learn biology.

The findings of this study are in line with [4], who emphasized that the experience of successful learning (mastery experience) is one source of the formation and strengthening of individual self-efficacy. When students successfully complete tasks and understand the learning material, their confidence in their abilities will increase. Through the use of AR-integrated SrVER-based learning modules, students can gain a structured, directed learning experience supported by real visualizations and active interactions. This learning process can help students better understand the complex, abstract material on the excretory system, thereby reducing feelings of doubt and lack of confidence when learning. Overall, the study's results indicate that the application of AR-integrated SrVER-based learning modules not only enhances the learning process by making it more active and engaging but also improves students' self-efficacy. The use of AR-integrated SrVER-based learning modules has a real positive impact, effectively improving student self-efficacy, especially in Biology learning on the excretory system.

The effectiveness of the AR-integrated SrVER-based learning module in improving students' self-efficacy is closely related to the combination of structured learning stages and interactive visualization. The SrVER model encourages students to actively participate in the learning process through screening, visualization, elaboration, and reflection activities, which gradually help students build confidence in their abilities. In addition, the integration of Augmented Reality provides more concrete and interactive learning experiences, enabling students to understand abstract excretory system concepts more easily. This condition helps reduce students' doubts and anxiety during learning, thereby increasing their confidence in completing learning tasks independently.

This study has several limitations. First, the study used a quasi-experimental design, which may not fully control for external variables that affect students' self-efficacy. Second, the research was conducted in only one school with a limited number of participants, so the findings may not be generalized to broader educational contexts. In addition, the implementation of Augmented Reality depended on students' devices and technical conditions during the learning process. Therefore, future studies are recommended to involve larger, more diverse samples and to apply AR-integrated SrVER learning modules to other biological topics or educational levels.

Conclusion

The study concluded that implementing the SrVER model-based learning module integrated with Augmented Reality (AR) effectively increased students' self-efficacy in excretory system material. This effectiveness was proven through data analysis, which showed a significant improvement, supported by the Mann-Whitney test, which produced an Asymp. Sig. (2-tailed) value of $0.003 < 0.05$. The use of this module not only helps students understand abstract biological concepts but also significantly strengthens their self-confidence in facing academic challenges continuously. These findings imply that integrating AR technology into structured learning models like SrVER has broader potential to transform biology education by making abstract, complex physiological systems more accessible and engaging for digital-native students. However, since this study was limited by its quasi-experimental design and a relatively small sample size in a single school, care should be taken when generalizing the results. Therefore, future research is highly recommended to conduct large-scale, multi-centered studies with more diverse student populations. Additionally, further investigations should examine the scalability of the AR-integrated SrVER approach across different scientific topics and educational levels to fully establish its long-term effectiveness.

Author's Contribution

R.A. Lestari: designed the learning module, conducted the research, analyzed the data, and wrote the article. B.S. Handayani and M.R. Adawiyah: supervisors who provided concepts, suggestions, direction, and full support. D. Setiadi: as instrument validator. T.A. Lestari: provided views and suggestions to the researcher.

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