JPPIPA 9(6) (2023)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Application of Scientific Based Modules to Improve High Order Cognitive Skills and Self Efficacy of Learners on Circulation System Material

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Received: April 12, 2023
Revised: May 8, 2023
Accepted: June 25, 2023
Published: June 30, 2023

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DOI: 10.29303/jppipa.v9i6.3808

Abstact: Students who are at a higher level such as high school should already have higher knowledge or known as High Order Cognitive Skills (HOCS). Within the scope of education, self-efficacy is very important because it can affect cognitive processes, motivation, actions and student achievement. This study aims to determine the differences in high order cognitive skills and self-efficacy in the experimental and control classes. This research is quantitative through a Quasi-Experimental design with a Non-randomized control group, pretest-posttest design. Sampling used a purposive sampling technique with a total sample of 124 students who were divided into two groups, namely the control group and the experimental group. The instrument used to measure HOCS uses multiple choice questions of 40 test questions while self-efficacy is measured using a self-efficacy questionnaire. Data analysis used Ancova at a significance level of 0.05. The results showed that there were differences in the increase in high order cognitive skills and there were differences in students' self-efficacy on circulation system material in class XI after implementing scientific-based modules. The conclusion from this study is that scientific-based modules can be applied to improve students' high order cognitive skills and self-efficacy in circulation system material.

Key word: Scientific Based Module; High Order Cognitive Skills; Self Efficacy

Introduction

The characteristics of the 2013 curriculum as stated in Permendikbud number 22 of 2016 are applying a scientific approach in the learning process. In accordance with the 2013 Permendikbud concerning the implementation of scientific-based learning activities curriculum includes 5 student learning activities namely observing, asking, gathering information, associating, and communicating. The 2013 curriculum has adopted and developed a scientific approach in the learning process to improve the quality of the learning process and graduates. Biology learning sometimes does not explore the ability to think or reason so that the ability to answer biology questions is still low. The problems faced by students in solving problems are that many students do not have the ability to solve questions systematically and find it difficult to digest the subject matter of the question. Students are also sometimes still difficult to determine the concepts, principles, theories to solve, answer or solve problems.

From 2014 to 2019, children's development occurred very rapidly, one of which was children's cognitive abilities. Cognitive development is an aspect that is quite intensively developed in early childhood in Indonesia. This is because there are still many parents who think that children who have high cognitive abilities are considered intelligent children who will succeed in their later lives. (Tatminingsih, 2019)

The cognitive domain of students with regard to intellectual learning outcomes according to Anderson et al. (2010) consists of six aspects, namely remembering (C1), understanding (C2), using (C3), analyzing (C4), assessing (C5) and create (C6). The cognitive abilities of a person are divided into two parts, namely low order cognitive skills and high order cognitive skills. Low

How to Cite:
Nora, H., Pada, A. U. T., Nurmaliah, C., Muhibbuddin, M., & Safrida, S. (2023). Application of Scientific Based Modules to Improve High Order Cognitive Skills and Self Efficacy of Learners on Circulation System Material. *Jurnal Penelitian Pendidikan IPA*, *9*(6), 4605–4613. https://doi.org/10.29303/jppipa.v9i6.3808

order cognitive skills are the three lowest levels in Anderson's taxonomy, namely remembering, understanding and using. In contrast, high order cognitive skills are the three highest levels, namely analyzing, assessing and creating.

Students who are at a higher level such as high school should already have higher knowledge or known as High Order Cognitive Skills (HOCS). Cognitive learning outcomes are students' abilities after what they know and learn. The categories in the cognitive process are remembering, understanding, applying, analyzing, evaluating and creating (Respati & Atun, 2023). Therefore, cognitive ability is one of the abilities that plays an important role in the success of the learning process, because most of the learning activities involve thinking and remembering. From a process, of course, each individual has his own process which will also affect the results of his cognitive abilities.

Based on the preliminary study, the selected schools were SMAN 8 Banda Aceh and SMAN 5 Banda Aceh and based on the results of interviews with the Biology teacher class XI-IPA, it was obtained information on the average value of students in class XI-IPA recorded on the Minimum Completeness Criteria, students were still in below the standard set by the school, namely 75. Low Minimum Completeness Criteria is influenced by the inability of students to answer high-level questions. High-level questions include analyzing, evaluating and creating. One of the material that is considered difficult by students is the circulation system material. Circulation system material is one of the materials in class XI which has a broad and complex scope. This is caused by the High Order Cognitive Skills (HOCS) of students who have not developed optimally in answering questions that are considered difficult.

One of the causes of learning difficulties experienced by students is poor self-efficacy. According to Alhadabi & Karpinski (2020) states that many factors can influence student preferences for certain types of goal achievement orientations. Some of these factors include a student's personal reflection (eg self-efficacy), combined with excessive grit, which can determine academic pathways. The attitude of each individual consists of a positive attitude and a negative attitude. Students who are active in learning so that their learning outcomes are good tend to have a positive attitude, while students who are not active in learning have poor learning outcomes and tend to have a more negative attitude (Tanti et al., 2021). Having a positive attitude in a person will increase self-confidence or what is commonly called self-efficacy (Ernawati, 2021). Within the scope of education, self-efficacy is very important because it can affect cognitive processes, motivation, actions and student achievement. Without self-efficacy, good learning outcomes will be difficult to achieve even if someone has good abilities.

The circulatory system material looks very abstract where this material cannot be conveyed verbally, but media is needed that can clearly describe various forms starting from blood components, circulatory system organs, circulatory system mechanisms to diseases related to the circulatory system so that it doesn't look too abstract and students can understand this material well. The use of innovative learning resources can influence high order cognitive skills and self-efficacy such as modules, one of which is a scientific-based module. Modules are teaching materials that contain learning objectives, guidelines for use, material descriptions, abstracts, evaluations, feedback, and follow-up, which are designed as independent learning tools (Hasbie et al., 2023). Scientific-based modules are equipped with materials, case examples and questions that encourage students to think. The application of the module is believed to increase the independence of students. So, the learning modules that are arranged contain not only subject matter but also contain work activities that can be used by students.

The scientific-based module contains and presents material and assignments that refer to a scientific approach, namely observing, asking questions, conducting experiments, analyzing and concluding. One of the characteristics of the scientific approach is that in addition to the learner-centered learning process, it also involves cognitive processes in stimulating the development of intelligence, especially students' higher-order thinking skills. This is in accordance with the opinion of Rusadi et al. (2019) saying that the scientific approach is also called a scientific process-based approach, sometimes also called a scientific-based approach.

Several studies report the effectiveness of implementing modules such as research conducted by Lewar & Suhartini (2023), namely the provision of modules in learning can improve students' cognitive learning outcomes, because the material presented in the module is described according to the level of student understanding. Independent learning with modules gives students freedom to study modules. This is in line with the research of Sukestiyarno et al. (2021) which states that students' independent learning can get used to using modules, resulting in increased self-efficacy. Another study, namely that conducted by Conradty et al. (2020) states that learning is more meaningful if students are actively involved in compiling the concepts presented in the module into cognitive knowledge. The module has the advantage of increasing the motivation and independence of students which affect self-efficacy.

Learning through modules can familiarize students with independent learning and increase self-efficacy.

Based on this, it is necessary to conduct research related to the application of scientific-based modules to improve students' high order cognitive skills and self-efficacy. The purpose of this study was to find out how students' high order cognitive skills and self-efficacy increased after applying the module to the circulation system material.

Method

This research was conducted at Banda Aceh Public High School which consisted of 2 schools, namely SMAN 8 Banda Aceh and SMAN 5 Banda Aceh. The approach used is quantitative with a quasi-experimental research type with a Non-Randomized Control Group design, Pretest Post-test Design (Ary et al., 2010).

The population in this study were all students in class XI IPA at SMA Negeri 8 Banda Aceh and all students in class XI IPA at SMAN 5 Banda Aceh, totaling 299 students with a sample of 124 students. Determination of the sample is determined by using a purposive sampling technique, namely the technique of determining the sample with consideration. Purposive sampling is used if the target sample under study already has certain characteristics so that it is impossible to be taken as a sample (Sugiyono, 2009). The researcher's consideration here is that the class taken as treatment is the class that has the same average biological value in class XI IPA students at SMAN 8 Banda Aceh and SMAN 5 Banda Aceh. In addition to having the same biological average score, other considerations are based on interviews with the teacher concerned and classroom observations. The sample table can be seen in table 1.

Table 1. Experiment and Control Class Research Samples

School	Sample	Number of Students	Biological Average Score
SMAN 5	XI IPA 4	31	71.24
Banda Aceh	XI IPA 5	31	71.18
SMAN 8	XI IPA 3	30	72.31
Banda Aceh	XI IPA 4	32	73.65

Research data collection instruments in the form of test and non-test instruments. The test instrument is in the form of objective test kits to find out students' high order cognitive skills through multiple choice tests given before and after learning by applying learning using scientific-based models. While the non-test technique used to measure students' self-efficacy is carried out through a questionnaire statement which totals 45 questions developed by Dr. Diana K May from the University of Georgia, the Self Efficacy instrument consists of three aspects, namely level, strength, generalization (May, 2009).

Data analysis was carried out on students' initial ability data (pretest score) and final ability data (posttest score) of students' high order cognitive skills. Prior to data analysis, tabulation was first performed. Tabulation is the compilation of data in tabular form and is carried out on students' pretest and posttest high order cognitive skills score data. To find out the increase in High Order Cognitive Skills measured, the calculation of the normalized average gain score data (N-gain) developed by Meltzer (2002) is used. Analysis of the average difference test was carried out on the average pretest score posttest score through ancova with the criteria if ($p < 0.05$) then Ha is accepted, whereas if ($p > 0.05$) then Ha is rejected. To calculate the average score from self-efficacy questionnaire data using Arikunto's formula (2010).

Result and Discussion

High Order Cognitive Skills

Analysis of data acquisition on the average pretest High Order Cognitive Skill of students between the experimental class and the control class is presented in figure 1. It can be seen that the students' initial abilities as a whole did not show any difference. However, after being given treatment with the application of scientific-based modules in the experimental class, the average post-test score increased more than the control group. The N-Gain data in the control class is 0.7 which belongs to the Medium category and the experimental class is 0.8 which belongs to the High category. The average scores of pre-test, post-test and N-gain high order cognitive skills of students in table 2.

Table 2. Average Scores of Pre-test, Post-test and N-Gain High Order Cognitive Skills of Students

Classes	Pretest Average	Postest Average	N-Gain
Experiment	26.19	79.00	0.80
Control	24.00	60.73	0.70

Cognitive abilities that need to be sharpened by children from an early age are their thinking abilities. Thinking is a part of high-level cognitive abilities that must be honed as early as possible, a part of high-level cognitive abilities, namely critical thinking (Yunita et al., 2019). The increase in students' HOCS in the experimental class was caused by the use of scientific-based modules. Learning activities using modules provide opportunities for students to use the concepts obtained in solving problems related to everyday life,

thus encouraging cognitive skills, especially High Order Cognitive Skills (HOCS) of students which include reading, learning, remembering, logical reasoning, and noticed. According to Shilo & Ragonis (2019) Appropriate questions can lead students to inquiry when finding various solutions to certain questions and how components of high-level cognitive thinking are received directly in the problem-solving stage presented. Stages of problem solving are high-level cognitive skills, namely critical thinking, making decisions and taking responsibility.

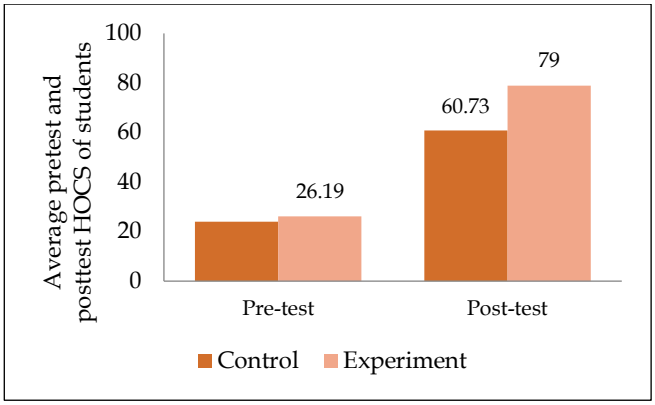

Figure 1. Average Scores of Pre-test and Post-test High Order Cognitive Skills of Students

Reasoning skills and critical thinking skills can increase because of the decision-making process to solve problems. Learning media in the form of scientific-based modules is proven to be able to improve students' High Order Cognitive Skills (HOCS). This is in accordance with the statement of Aisyiah & Amrizal (2020) stating that learning resources and learning media are really needed in the learning process. It is hoped that later scientific approach learning will be able to develop students' cognitive, affective, and psychomotor attitudes.

Cognitive abilities are shown by the success of students in the classroom after receiving learning and undergoing evaluation in the post test process. High-level cognitive abilities are measured based on Bloom's taxonomy starting from analyzing, evaluating, and creating in the posttest process so that significant differences can be seen. Some students still experience difficulties in solving questions at the analyze, evaluate, and create levels, especially in the control class. This is due to the ineffective learning activities in the control class because students only obtain information by discussions between group friends and from the teacher, while the learning media used are only in the form of textbooks even with a limited number, especially at SMAN 5 Banda Aceh, thus causing the learning process in the control class is not optimal.

According to Bely et al. (2019) students who hear and accept the lessons conveyed by the teacher tend to be passive, this causes students' cognitive learning outcomes to be low. This was also stated by Ramdani et al. (2020) in his research saying that the success of students is also influenced by the completeness of learning facilities. Students have limited opportunities to learn material, because science textbooks for students in both classes are not enough. So that students experience learning difficulties.

Table 3. Students' Ancova High Order Conitive Skills Test

Source	Type I Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	10437.932[a]	3	3479.311	68.236	.000
Intercept	605222.331	1	605222.331	11869.5	.000
Class	10352.331	1	10352.331	203.029	.000
Pretest	12.165	1	12.165	.239	.626
Class*	73.436	1	73.436	1.440	.232
Error	6118.738	120	50.989		
Total	621779.000	124			
Corrected Total	16556.669	123			

The results of the ancova test (covariance analysis) in Table 4.2 show that the Probability (Sig.) Class 0.000 <0.05 means that there is a significant or significant difference in high order cognitive skills between the experimental class and the control class and the probability (Sig.) Class * Pretest 0.232 ≥ 0.05 means that there is no difference in pretest scores between the experimental class and the control class.

Learning in the experimental class after being given treatment using a scientific-based module on circulation system material, the post-test scores increased more than the control group. This is because scientific-based modules can build students' understanding by providing complete information from the various forms presented. Students learn by understanding pictures complete with sentence explanations, working on discussion questions so that students are able to convey their understanding and ideas, besides that student also work on independent assignments that are useful for training and testing their own abilities through practice questions that have been presented as a task. By doing these assignments students can develop independent learning abilities. In addition, it can be seen the difference that students in the experimental class can solve problems based on Bloom's taxonomy starting from analyzing, evaluating, and creating in the posttest process. According to Ashyfah (2023) says that the module is one of the teaching materials that aims to

present material to students so they can study it independently.

In addition to the use of modules, the difference in increasing high order cognitive skills between the control class and the experimental class was due to using different learning models. In the experimental class using the learning model of discovery learning while in the control class using cooperative learning learning model. In the experimental class, the discovery learning model is used which is combined with scientific-based modules so that learning becomes more effective than the control class because the discovery learning model can encourage students to be able to gain new knowledge independently. A scientific approach uses discovery learning According to Masril (2018), the discovery learning model helps students build knowledge based on existing prior knowledge. This is because according to the opinion put forward by Andayani (2020) that the Discovery Learning model is a learning activity that emphasizes students' abilities to prove hypotheses actively and independently.

Based on the pretest, posttest and N-Gain data above, learning biology using scientific-based modules can improve students' cognitive skills. This was explained by Komalasari (2019) that learning science using a scientific approach is contextual so that it directly comes into contact with the real life and experiences of students, because in the observation phase students should be given phenomena that are appropriate to the context of students to provide opportunities for students to connect concept of material in school with his life. In addition to distinguishing between the experimental class and the control class in the learning process and results, there are also differences in students between SMAN 5 Banda Aceh and SMAN 8 Banda Aceh. Students at SMAN 8 Banda Aceh seem to have higher cognitive abilities than SMAN 5 Banda Aceh. This is because students at SMAN 5 Banda Aceh are less enthusiastic in the learning process so that it affects their cognitive abilities.

Self Efficacy

The results of the Ankova self-efficacy test for students in the control class and experimental class are presented in Table 4. Based on table 4. shows a significant difference in self-efficacy results. The results of the ancova test (covariance analysis) showed that the Probability (Sig) of Kleas was 0.000 <0.05, meaning that there was a significant or significant difference in self-efficacy between the experimental class and the control class. Based on the analysis of the average self-efficacy score in the experimental class and the control class, it can be seen that the experimental class obtained a higher average score compared to the control class. The average self-efficacy score for the experimental class was 78.90 which could be categorized as good, while in the control class the average self-efficacy score was 56.03 which could be categorized as sufficient. This is because learning in the experimental class using scientific-based modules makes students more enthusiastic and more interested in participating in the learning process. The average score of self-efficacy in the experimental class and control class can be seen in figure 2.

Table 4. Student self-efficacy Ancova test

Source	Type I Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	16215.516[a]	1	16215.516	612.199	.000
Intercept	564705.032	1	564705.032	21319.8	.000
Class	16215.516	1	16215.516	612.199	.000
Error	3231.452	122	26.487		
Total	584152.000	124			
Corrected Total	19446.968	123			

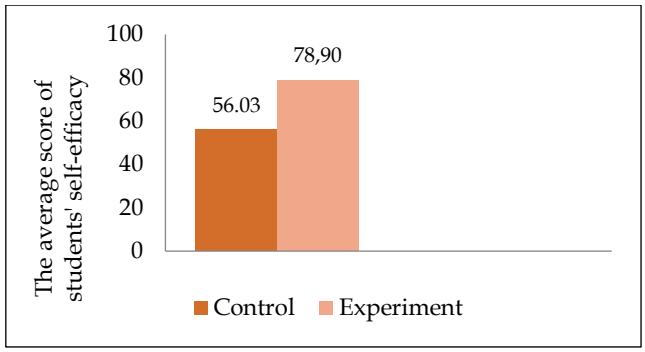

Figure 2. Average Student Self-Efficacy Score

Based on the analysis of the average self-efficacy scores of students, it can be seen that the experimental group obtained a higher average score than the control group. The mean self-efficacy score of the experimental group students was 78.90, while that of the control group was 56.03. The difference in the mean self-efficacy score between the control group and the experimental group occurs due to the application of different learning methods. The experimental group was taught with scientific-based modules so as to obtain a higher average self-efficacy score than the control group.

Systematic and interesting learning materials are expected to motivate students to study independently outside the classroom. So that the learning process will continue until students can master the material presented (Puspita, 2019). The use of scientific-based modules at each circulation system material meeting makes students have high self-efficacy. Giving independent assignments and group assignments in modules makes students more often practice students'

abilities in the material. Students will remember the material that has been taught so that students have high confidence in completing learning. According to Zhao et al. (2021) cognitive affective learning theory with media conceptualizes types of learning media in a framework that combines cognitive and affective aspects. To examine affective factors, the value theory of achievement emotion control refers to emotions related to learning achievement. These can be distinguished by their belief in self-efficacy, which serves as an indicator of cognitive control.

According to the theory, students' cognitive characteristics can be influenced by self-efficacy in learning readiness. Readiness is the willingness to respond or react. The condition of students who are ready to receive lessons from the teacher will try to answer the questions that have been given by the teacher. In order for students to be able to give correct answers, of course students must have knowledge by reading and studying the material to be taught and what has been taught by the teacher. The condition of students who are healthy, enthusiastic and not sluggish, will more easily accept lessons from the teacher. The condition of healthy students will encourage students to stay focused and pay attention to the explanations given by the teacher. All of these things are part of the self-efficacy of students who are already at a good and optimal stage (Guest, 2022).

Bandura (1994) states that self-efficacy has three dimensions, namely level, strength and generality. Each of these dimensions has important implications for a person's performance. Level refers to the order of tasks according to their level of difficulty. Strength refers to the belief that exists within a person that can be realized to achieve certain performance. Generality refers to the flexibility of one's self-efficacy that can be applied in other situations. Based on the three aspects of self-efficacy, it can be seen that the average of the experimental class and the control class is shown in Figure 3.

Figure 3. shows the self-efficacy of control and experimental class students based on self-efficacy categories. The experimental class obtained an average score on the level aspect of 78.58, the strength aspect of 77.79, and the generality aspect of 75.99. Meanwhile, in the control class, the highest average score was in the generalization aspect with a score of 57.10, while the lowest score was in the level aspect with a score of 53.65 and strength with a score of 55.04. Students in the experimental class have higher scores on the level aspect, this is because they are able to do the assignments given. As long as they study with the module, they are used to learning independently and practicing answering the questions in the module. Apart from that, with group assignments they are required to be used to solving problems, discussing and presenting. In contrast to the control class, the level score looks the lowest among the other aspects, this is because they are not sure they are able to do the assignments due to a lack of experience in learning. Therefore they only do easy tasks and tend to avoid difficult tasks.

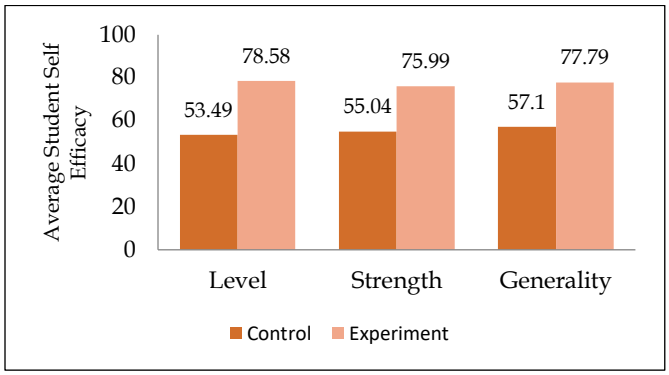

Figure 3. Average Self-Efficacy Indicators of Experiment Class and Control Class Students

Self-efficacy on strength indicators can help students to overcome their learning difficulties so that students are more enthusiastic about completing difficult tasks as a challenge. The strength indicator helps confidence and self-confidence in overcoming learning difficulties. This is in accordance with research of Yolantia (2019), which states that students in the experimental class have higher scores in this aspect because they feel confident and have tenacity and stability in doing assignments, when facing challenges they persist with all efforts and are not easy. give up. Learning with the PBL module has given them challenges in the form of demands to have analysis in solving problems and exploring abilities. On the generality indicator, namely students are able to demonstrate their ability to respond to various situations well, positively, and effectively, making previous experience a learning process.

Students with a high level of self-efficacy will try to master the subject matter compared to students with low self-efficacy. The results of this study are in line with Syapira's research (2022), namely when a student has low self-efficacy, the student tends to have a high level of procrastination, and vice versa. When the level of student self-efficacy is high, the academic procrastination experienced is low. Procrastination itself is a behavior that is deliberately carried out and a waste of time. This was also stated by Fitri et al., (2023) in his research stating that high self-efficacy will help students create a feeling of calm in dealing with problems while students with medium and low self-efficacy easily give up in facing problems and tend to become stressed.

According to Bandura, if an individual has low self-efficacy then the individual tends to give up easily and is helpless.

At the aspect level, students in the experimental class have a higher score, in this aspect because they feel confident and have more effort and do not give up in facing challenges in the learning process. Learning to use scientific-based modules has given them challenges in the form of demands to have analysis in solving problems consisting of a series of activities that require commitment to work. Aspects of strength, help confidence and confidence in overcoming learning difficulties. The generality aspect in the experimental class is also higher than the control class. This happens because they are able to make experience as a step to increase self-efficacy. In contrast to students in the control class, they felt unsure of their abilities when they were in situations and activities that were different from before.

Based on the average value of students' self-efficacy on circulation system material, it was concluded that the use of scientific-based modules could increase students' self-efficacy in the experimental class. By increasing self-efficacy, students can achieve educational goals to the fullest. This is in accordance with the statement of Amalya et al. (2021) stating that students must have high self-efficacy, so that they can support the success of the learning process and can improve student learning achievement, thus it is hoped that students will no longer have negative assumptions about their abilities. in study.

Conclusion

The conclusion of this study is that there are differences in the increase in High Order Cognitive Skills between the control class and the experimental class and there are differences in the Self Efficacy of students between the control class and the experimental class in the circulation system material.

Acknowledgment
Thanks to Nurrizayani, S.Pd and Dra. Nuriah as school principal at SMAN 8 Banda Aceh and SMAN 5 Banda Aceh. dr. Sari Rezeki and Yusriati, S.Pd., M.Pd. as a biology teacher at SMAN 8 Banda Aceh and SMAN 5 Banda Aceh. As well as students of class XI IPA at SMAN 5 Banda Aceh and SMA 8 Banda Aceh who were willing to participate in this research.

Author Contribution
Conceptualization: Hilwah Nora, data curation: Andi Ulfa Tenri Pada, Cut Nurmaliah, funding acquisition: Hilwah Nora, methodology: Hilwah Nora, Andi Ulfa Tenri Pada, Cut Nurmaliah, writing original draft: Hilwah Nora, writing review: Andi Ulfa Tenri Pada, Muhibbuddin, Cut Nurmaliah, Safrida, editing: Hilwah Nora

Funding
This article was independently funded by Hilwah Nora

Conflicts of Interests
This article has no conflict between authors.

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