

**Interactive Socio-Scientific Inquiry: The Effects on Creative Thinking Skills****Tasya Indriani* & Ummi Nur Afinni Dwi Jayanti**

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Abstract: Creative thinking skills are an important factor in learning whose implementation is still being questioned in various schools in Indonesia. This quantitative study aims to determine the effect of the Interactive Socio-Scientific Issue model on the creative thinking ability of students in class X SMA/MA. This study involved 60 students who were positioned as research subjects. Creative thinking skills data were collected using the essay test integrated creative thinking skills rubric. The data collected were analyzed using descriptive statistics in the form of mean and analytic statistics in the form of the ANCOVA test. The results of this study inform that the profile of creative thinking skills of class X high school students has increased which can be seen from the results of pre-test and post-test in the experimental class and control class. Furthermore, indicators in creative thinking skills that developed in this study were indicators of flexible thinking in the experimental class and the highest improvement in the original thinking aspect which was seen based on the results of the post-test that had been carried out. Following up on the findings of this study, empowering creative thinking skills using the Interactive Socio-Scientific Issue model is appropriate for use in subjects, especially Biology

Keywords: creative thinking, environmental change, socio-scientific issue.

Abstrak: Keterampilan berpikir kreatif termasuk faktor penting dalam pembelajaran yang implementasinya masih dipertanyakan diberbagai sekolah di Indonesia. Studi kuantitatif ini bertujuan untuk mengetahui pengaruh model Interactive Socio-Scientific Issue terhadap kemampuan berpikir kreatif peserta didik kelas X SMA/MA. Penelitian ini melibatkan 60 siswa yang diposisikan sebagai subjek penelitian. Data keterampilan berpikir kreatif dikumpulkan dengan menggunakan rubrik keterampilan berpikir kreatif terintegrasi tes esai. Data yang terkumpul dianalisis menggunakan statistika deskriptif berupa rerata dan statistika analitik berupa uji ANCOVA. Hasil penelitian ini menginformasikan bahwa profil keterampilan berpikir kreatif siswa kelas X SMA mengalami peningkatan yang dapat dilihat dari hasil pre-test dan post-test pada kelas eksperimen dan kelas kontrol. Lebih lanjut, indikator dalam kemampuan berpikir kreatif yang berkembang pada penelitian ini adalah indikator berpikir luwes pada kelas eksperimen dan peningkatan tertinggi pada aspek berpikir orisinil yang dilihat berdasarkan hasil post-test yang telah dilakukan. Menindaklanjuti temuan pada penelitian ini, maka pemberdayaan keterampilan berpikir kreatif menggunakan model Interactive Socio-Scientific Issue layak digunakan pada mata pelajaran khususnya Biologi.

Kata kunci: berpikir kreatif, perubahan lingkungan, socio-scientific issue.

▪ INTRODUCTION

The education system is one of the main aspects that play an important role in facing future challenges (Rahmawati et al, 2018). It has been agreed that the purpose of science education, including biology education, is to improve scientific literacy, namely to prepare students to become citizens who are science literate and responsible for the harmony of the world as a result of the development of science and technology and its impacts (Dawson, 2015). To realize this goal, it is necessary to improve students' creative thinking skills in learning biology (Sari, 2018). These skills are able to develop

students into active citizens and are able to form opinions and solve problems (Cofre et al, 2017). Higher order thinking processes include creative thinking which is rarely applied (Supardi, 2015). In fact, the learning skills needed in the 21st century lead to creativity and innovation (creativity and innovation), critical thinking and problem solving (critical thinking and problem solving), communication (communication), and collaboration (collaboration) (Suyonto, 2019). Therefore, efforts to develop creative thinking skills are seen as very important in learning biology.

Concepts are needed that put more emphasis on the ability to come up with solutions or ideas in solving problems encountered in learning (Astuti, 2019). In line with that, inquiry-based learning is able to develop students' conceptual abilities and can train creative thinking skills through maximum student involvement in investigating a problem systematically, critically, logically, analytically so that they can formulate their own answers to the problems given (Gulo, 2005). . The inquiry-based learning process allows students to find, and use various sources of information and ideas that can be used to improve understanding of problems or phenomena (Kaltakci, 2011). The various potentials contained in the inquiry learning are expected to be able to improve students' creative thinking skills.

In connection with increasing creative thinking skills, Socio Scientific Issues (SSI) is able to develop students' cognitive abilities to contribute in deciding problems rationally (Hadi et al, 2021). Through SSI, students are challenged to consider the scientific principles that underlie certain issues and analyze scientific data that can inform negotiations on these issues (Zeidler & Nichols, 2009). To solve problems or dilemmas identified from relevant social problems, students collaboratively decide on actions, find answers to certain questions, or draw reasonable conclusions (Wang et al, 2017). In general, issues including SSI are controversial and cause a lot of debate so that they can train students to develop certain skills, including creative thinking skills (Sadler, 2004).

Lindren (in Yamin, 2013) defines creative thinking as a possible answer or problem solving based on the information provided and sparks many ideas on a problem. Teachers play an important role in efforts to foster creative thinking skills by providing opportunities for students to play an active and free role in finding creative ideas. In line with this, Putra et al (2016) argue that students who have creative thinking skills create new ideas based on the knowledge they already have to solve problems from different perspectives. Guilford (in Munandar, 2009) said that the indicators of creative thinking in students consist of three aspects, namely fluency, flexibility, and originality. Fluency refers to the correctness and fluency of the answers given by students. Flexibility refers to the different and varied ways students are given in solving problems. Furthermore, originality refers to a new way that emerges from the students themselves and is only owned by students which is poured in solving problems.

The improvement in students' creative thinking skills has not run optimally in biology learning (Astuti, 2017). This condition is caused by biology learning that still revolves around core knowledge or a body of knowledge without paying attention to other aspects, one of which is thinking skills possessed by students (Widhy et al, 2013). In addition, Rahmawati et al, (2018) in their research said that teachers have not been maximal in training and guiding students towards creative thinking, only giving questions without a discussion process and scientific steps. In fact, one of the essence of

biology is that biology is a dimension of way of thinking which is the fundamental substance in learning biology as a scientific process to shape the mindset of students (Widhy et al, 2013). Socio-scientific issues can also be developed as a framework to engage students in meaningful and relevant scientific discourse in the development of learning biology (Macalalag et al, 2019).

As the Qur'an has provided guidance on various basic issues such as aqidah, sharia, and morality, by laying out principle paths regarding various issues. The Qur'an certainly did not come down just like that, this holy book was brought by Allah's messenger, Prophet Muhammad SAW. To be able to explore what is contained in the Qur'an and other sciences requires a clear way of thinking, as stated in the word of Allah SWT in QS an-Nahl verse 44, which reads:

الْبَيِّنَاتِ الرُّبُوبِ أَنْزَلْنَا إِلَيْكَ الذِّكْرَ لِتُبَيِّنَ لِلنَّاسِ أَلِ الدِّينِ لَعَلَّهُمْ

“We have sent down to you the Qur'an, so that you may explain to mankind what has been revealed to them and so that they may think”.

Based on Tafsir Jalalain (Ministry of Religion of the Republic of Indonesia, 2009) explains that (by bringing information) this pronunciation is ta'alluq to fi'il; meaning We sent them with clear evidence (and books) namely the holy book of the Qur'an. (And We have sent down to you the Adh-Dhikr) namely the Qur'an (so that you explain to mankind what was revealed to them) in which there is a distinction between lawful and unlawful (and so that they think about it) and then they take lessons from it. That verse explains that studying the Qur'an is an obligation. Especially when it comes to science. This issue is very important, especially at this time, where the development of science is very rapid and covers all aspects of life. To achieve this knowledge, of course, must be achieved with an effort of mind. Because thinking is an attempt to glorify humans more.

Various studies on the integration of socio-scientific in biology learning have been carried out. However, most of these studies are more integrated with socio-scientific learning model on Problem Based Learning literacy skills (Azizah et al, 2021). Furthermore, Suryani (2019) examines the Group Investigation (GI) learning model combined with socio-scientific issues to improve conceptual understanding and problem solving skills. The research that examines the application of the Interactive Socio Scientific Issue (ISSI) model was conducted by Hadi et al (2021) which focused on the variables of scientific literacy, biological concepts and critical thinking. This opens an opportunity to examine the influence of the ISSI model on other 21st century skills, especially creative thinking skills.

The purpose of this study was to determine the effect of the ISSI model on the creative thinking skills of tenth grade of high school students. The formulation of the problem in this study is, is there an increase in creative thinking skills through the application of the Interactive Socio-Scientific Issue (ISSI) model on the Environmental change material for tenth grade of high school biology subject?. This research needs to be done because it can provide information about how the ISSI model influences students' creative thinking skills. The results of this study are expected to arouse the motivation of teachers to be able to provide learning experiences that can develop/empower creative thinking skills given to students through scientific learning models related to contextual problems that exist around students.

▪ **METHOD**

This research is a quasi-experimental research (Quasi Experiment). Quasi experiment is a research method used to find the effect of certain treatments on others under controlled conditions (Sugiyono, 2012). The learning approach used is Interactive Socio-Scientific Inquiry. Science program students at one of the senior high schools in Deli Serdang Regency were given the Interactive Socio-Scientific Inquiry to determine the effect of the ISSI approach on students' creative thinking skills. The experimental design used was a pretest-posttest control group design.

Participant

According to Arikunto (2006), the population is the entire research subject. The population of this study was all students of the science program at one of the senior high schools in Deli Serdang Regency totaling 60 students. The sample is part of the number and characteristics possessed by the population (Sugiyono, 2010). All members of the population were the research sample. This technique is used because Saturated Sampling is part of the Nonprobability Sampling that uses all members of the population as a sample.

Instruments

The instrument used in this study was a test. The test in this study was used to determine the increase in creative thinking skills of each student. The tests in this study were in the form of pre-test and post-test which consisted of 5 questions in the form of an essay test. The test instrument has been validated with validation results of 100% on the material aspect, 80% on the construction aspect, and 80% on the language aspect. Based on the percentage calculation, the validation results are included in the very feasible category.

Data Collection

The methods used to collect data are tests, and documentation. The tests used in this study were pre-test and post-test. The test is given to obtain quantitative data, namely data on the value of student learning outcomes after receiving learning that can be analyzed descriptively. Researchers gave tests to students at the end of the lesson to determine the level of student mastery of learning Biology on the environmental change material that has been studied. Documentation in this study also includes data collection from resources, such as documents and photographs.

Procedure

This study is divided into 3 stages, namely, the preparation stage, the implementation stage and the completion stage. The preparatory stages carried out are, determining the research population, making Learning Implementation Plans (RPP), making student worksheets, making test questions grids, compiling research instruments in the form of essay test questions, conducting test instruments for expert lecturers Biology. The activities carried out at this implementation stage are, giving pre-tests to students before carrying out the learning process consisting of 5 essay test questions, carrying out the learning process for environmental change materials using the

Interactive Socio-Scientific Inquiry by providing worksheets which contains learning activities according to the ISSI syntax, namely the engagement stage exploration stage explanation stage elaboration stage, and evaluation stage. ISSI syntax in learning can be seen in Table 1

Table 1. ISSI syntax in learning

No	Syntax	Learning activities	Implementation
1	<i>Engagement</i>	The teacher presents the <i>Socio Scientific Issue</i> in the form of a video about the dangers of global warming. Students identify, then make questions and provide these from what they have watched. Things that are identified in the form of factors that affect environmental changes, as well as the impact of environmental changes.	Face-to-face meeting
2	<i>Exploration</i>	The teacher distributes Student Worksheets (LKPD) with material on environmental change. Students are asked to analyze the images that have been presented in the LKPD in the form of various examples of changes in the environment around them.	Face-to-face meeting
3	<i>Explanation</i>	Students conduct discussions in study groups consisting of 4-5 people. Students are given the opportunity to formulate problems and hypotheses according to what they see in the pictures that have been presented in the LKPD. Students conduct a literature review from several sources that have been agreed upon.	Face-to-face meeting
4	<i>Elaboration</i>	The teacher provides opportunities for study groups to present their work. Each group must present their work in front of the class.	Face-to-face meeting
5	<i>Evaluation</i>	The teacher guides and asks students to conclude the results of the discussion and learning materials. Give appreciation to groups that have worked well.	Face-to-face meetings

In the last stage, namely the completion stage which consists of processing data after taking data from the treated class, carrying out a data analysis process in the form of a prerequisite test consisting of a normality test and a homogeneity test, then proceeding with conducting an ANCOVA test, drawing conclusions from the results of data analysis. that has been completed, prepare a report by completing the attachments related to the research.

▪ **RESULT AND DISSCUSSION**

Data Description Creative Thinking Skills

This research has produced data in the form of quantitative data. The data obtained by using the creative thinking ability test of students on the Interactive Socio-Scientific Inquiry on environmental change material. The increase in students' creative thinking skills was obtained from the difference between the posttest and pretest scores in the learning activities of each class. The maximum value used to assess students' creative thinking skills is 100. Based on the results of descriptive analysis, it shows an increase in creative thinking skills in both research classes. The two classes showed the results of the pretest data that did not differ much. In the experimental class, the pre-test with an average (mean) of 66.70 and a standard deviation of 10.9 while for the posttest value, the mean (average) was 91.40 with a standard deviation of 4.2. In the control class, the pre-test with an average (mean) of 64.63 with a standard deviation of 11.1, while for the post-test value, an average (mean) of 80.93 was obtained with a standard deviation of 9.7.

To find out whether the Interactive Socio-Scientific Issue Inquiry learning mode is effective or not on the pre-test and post-test scores that have been given, a normalized n-gain test is carried out. The results of n-gain test are presented in Figure 1.

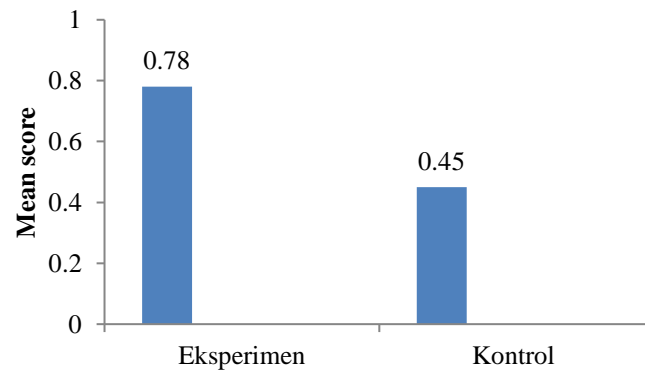


Figure 1. Graph of average n-gain

The data in the graph shows the average value of the n-gain normalized. In the experimental class, a n-gain score of 0.78 was obtained. Based on the gain, it can be concluded that the data is in the "effective" category, namely n-gain > 0.7. Furthermore, the control class obtained a n-gain score of 0.45. Based on the normalized gain criteria, it can be concluded that the data is in the "less effective" category, namely n-gain < 0.7. Further analysis was carried out on indicators of creative thinking skills which include fluent thinking, flexible thinking, original thinking, detailed thinking, and judgmental thinking which are presented in Figure 2.

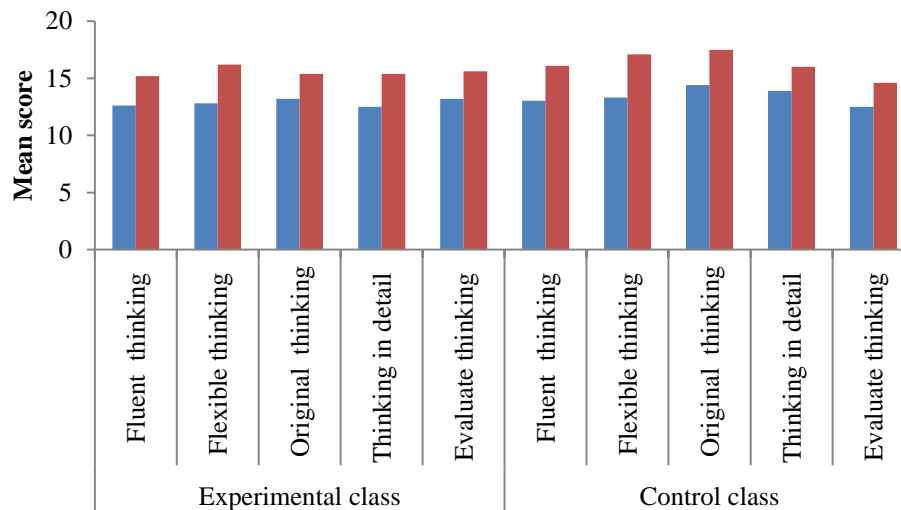


Figure 2. Average pretest and posttest of students' creative thinking skills between experiment class (red) and control class (blue)

Based on Figure 2, it is known that the experimental class with the results of the pretest showed the highest improvement for aspects of original thinking and judgmental thinking, while the control class showed the highest improvement for aspects of original thinking and detailed thinking. Meanwhile, in the experimental class the posttest showed the highest improvement for the flexible thinking aspect and the control class showed the highest increase for original thinking and flexible thinking aspects.

Analysis of Covariance (ANCOVA) statistical test was used to determine differences in creative thinking skills through the application of the Interactive Socio-Scientific Issue model with the pretest as a covariate. The data used for the ANCOVA test must be pre-tested. The results of the prerequisite test and hypothesis testing are described as follows. Based on the data obtained using the Kolmogorov-Smirnov test, the sig. for the experimental pretest was 0.147, and the posttest data in the experimental class obtained a sig value of 0.200. Meanwhile, in the control class data, for the pretest, the sig value was obtained. is 0.146, and the posttest data in the control class obtained a sig value. 0.138. Thus, it can be concluded that all data are normally distributed (sig > 0.5). After doing the normality test, the next step is to do the homogeneity test. The homogeneity test is carried out with the aim of showing that two or more groups of sample data that have been taken come from populations that have the same variance. Based on the data obtained, it can be seen that the results of the output test of Homogeneity Variance, the pre-test value shows a significance value for based on mean = 0.937, for based on median is 0.972, based on median with adjusted df = 0.972, and based on trimmed mean is 0.931. The conclusion from the data obtained is homogeneous because the p-value > 0.05.

After testing the prerequisites in the form of normality test and homogeneity test, it can be continued with the ANCOVA test. In this research data analysis using the ANCOVA test because there are two classes being compared, namely the experimental class and the control class and there is a pretest as a covariate. Thus, the ANCOVA test is indeed feasible to calculate the required data analysis. Based on the results of the ANCOVA using SPSS 26.0 for windows software, it can be seen that the corrected

model shows a significance < 0.05 , meaning that the pre-test and the learning model given simultaneously have different impacts on learning outcomes. The intercept shows a constant value with a significance < 0.05 . The significance value of the pre-test < 0.05 , meaning that the pre-test had an impact on learning outcomes. The learning model shows a significance value < 0.05 , meaning that the two learning models have a significant difference in learning outcomes.

Based on the results of the ANCOVA test, then a hypothesis test analysis was carried out to determine whether H_0 was accepted or rejected with the following procedure. Criteria for acceptance and rejection of the hypothesis using the following criteria: H_0 accepted and H_a rejected if the significance value or error probability value (α) > 0.05 . In the other hand, H_0 is rejected and H_a accepted if the significance value or error probability value (α) is > 0.05 . The hypothesis to be tested in this study is $H_0: 1 = 2$, there is no significant difference in learning outcomes in the application of the Interactive Socio-Scientific Issue learning model in terms of students' creative thinking skills on environmental change material. $H_0: 1 \neq 2$, there are significant differences in learning outcomes in the application of the Interactive Socio-Scientific Issue learning model in terms of students' creative thinking skills on environmental change material. Based on the hypothesis test that has been carried out, it is known that the Sig value < 0.05 , it can be concluded that there is a difference between the treatment given to the post-test. So it can be concluded that there is an influence of the Interactive Socio-Scientific Issue model on students' creative thinking abilities.

After calculating the research data, it was found that the creative thinking skills of science program students at one of the senior high schools in Deli Serdang Regency on the material of environmental change experienced an increase. At the time of the pre-test, 30 students (100%) were declared incomplete with a minimum score of 75.00 completeness criteria with an average value of 66.70 and a standard deviation of 10.97. After using the Interactive Socio-Scientific Inquiry approach to the material on environmental change, a post-test was given to determine student learning outcomes. Calculation of research data obtained by students who completed as many as 30 students (100%) with a minimum score of 75.00 completeness criteria, an average value of 91.40 and a standard deviation of 4.215.

The results showed that there was an effect of the Interactive Socio-Scientific Inquiry approach on increasing students' creative thinking skills on environmental change material at one of the senior high schools in Deli Serdang Regency. Where in the experimental class there is an average posttest value greater than the average pretest value. Based on these results, the ability to think creatively using the Interactive Socio-Scientific Inquiry is superior to the ability to think creatively with the conventional model used in the control class. The Socio-Scientific Issue (SSI) approach is a strategy that aims to stimulate intellectual, moral and ethical development, as well as awareness of the relationship between science and social life (Zeidler et al., 2005 and Nuang Chalerm, 2010). Based on this stimulation, the creative thinking ability of students has increased.

Based Natural Sciences abilities Socio-Scientific Issue- that can be developed is critical thinking skills.) and creative thinking (creative thinking) which shows the level of development of a person's interaction in terms of collecting and analyzing information or data from various sources. Learning activities using the Socio-Scientific

Issue that raise issues in the environment of students can trigger students to express ideas or ideas to solve existing problems. This is because the emotional emergence of students on social problems that occur in the surrounding environment.

The learning syntax that was carried out during the Interaction Socio-Scientific Issue consisted of 5 stages, namely the engagement, exploration, explanation, elaboration, and evaluation based on indicators of creative thinking skills, namely fluent thinking, flexible thinking, original thinking, detailed thinking, and think judging. First, at the engagement In this case, the teacher tries to focus students' attention and engage students in a new concept by asking motivational questions, providing an overview of the material to be studied, or other activities to develop students' curiosity. That way students will be trained to run indicators in creative thinking, namely thinking fluently. Next is the exploration, which at this stage provides a real experience for students. Students are invited to be directly involved in the phenomenon or situation they are investigating. At this stage students are expected to be able to carry out creative thinking indicators, namely flexible thinking. Then, the explanation is a phase when students' attention is focused on certain aspects of their experience in the previous phases. Students are given the opportunity to demonstrate understanding of their concepts, process skills, or behaviors. At this stage, students are expected to be able to explain something based on their own thoughts and have original value, so that they are trained to carry out aspects of original thinking. In the elaboration stage, Students are facilitated to be able to apply the concepts they have acquired based on the activities they have done into new situations or problems. At this stage, students are expected to be able to carry out creative thinking indicators, namely thinking in detail. Lastly, evaluation. At this stage the teacher finds out the quality and quantity of students' understanding of the topics that have been studied. This phase can be realized in formal or informal methods.

The significant finding of this study is that students gain substantial benefits in increasing their biological knowledge, and creative thinking skills through the Interactive Socio-Scientific Inquiry. This research provides information for implementing ISSI in biology education. ISSI helps students to use a scientific approach in recognizing problems and learning to make decisions about socio-scientific problems (Xiao & Sandoval, 2017). Correspondingly, integrating socio-scientific issues into science classrooms to improve students' science knowledge has also been reported in other studies (Sadler & Donnelly, 2006). It provides details of increasing scientific knowledge, particularly biological knowledge. Hadi et al. (2021) also conveyed in their research that it supports the application of socio-scientific as an instructional approach to improve scientific literacy skills, increase biological knowledge and develop students' thinking skills.

According to Zeidler et al. (2005), the application of SSI in learning has an important role because: (1) it makes science learning more relevant to students' lives; (2) means that direct learning outcomes such as appreciation of the nature of science; (3) improve the ability to argue; (4) improve the ability to evaluate scientific information; and (5) is an important aspect in scientific literacy. By encouraging greater student engagement through relevant social issues stemming from the discipline, socio-scientific issues have demonstrated their potential to minimize classroom management problems and provide problem solving and science content acquisition opportunities

(Sampson et al, 2012). In addition, Socio-Scientific can develop students through the exploration of social issues and their implementation in the school environment, thereby creating more meaningful learning (Zeidler & Keefer, 2003).

▪ CONCLUSION

Based on the research that has been done and data analysis, it can be concluded that there is an effect of the Interactive Socio-Scientific Issue on the creative thinking ability of students on environmental change material. After learning using the ISSI model there was an increase in the indicators contained in creative thinking. The Interactive Socio-Scientific Issue can be a future effort to be applied in biology learning because it motivates students to explore their potential. ISSI can be an alternative in the learning process as a facility needed in 21st century learning. Researchers realize that in this research, there are still some limitations, including: Students are not familiar with learning using the ISSI model because students often get direct learning with teachers by providing the material as a whole by not providing opportunities for students to learn to find their own concepts and school facilities that are still not optimal. The researcher's suggestion for further research is that the learning process should be varied with teaching materials and learning media that are fun and train students' independence more.

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