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Improving Students' Creative Thinking Skills in Mathematics Through Solving Open-Ended Problems

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Abstract This study aims to improve students' creative mathematical thinking skills through solving open-ended problems. The method used in this study is Classroom Action Research (CAR), which consists of several stages: planning, implementation, observation, and reflection. The research subjects were 36 students. The results obtained from this study are that learning by solving open-ended problems can improve students' creative mathematical thinking skills, but not all achievement indicators are met. In cycle I, one student who answered in the non-creative category was very much while only a few were in the fairly creative category. In the second cycle, there was a change where students who answered in the non-creative category decreased and students who responded in the fairly creative category increased.

Keywords Creative Thinking; Mathematics; Open-ended problem

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INTRODUCTION

Mathematics can be learned since we are still in Kindergarten (TK). However, many students assume that mathematics is complicated for students to understand, so students sometimes feel bored to learn it, resulting in lower mathematics learning achievement (M. Baidawi, Khasanah, et al., 2023). This is very concerning because mathematics is widely used in everyday life. Therefore, efforts are needed to make it easier for students to learn mathematics. (Tisngati & Genarsih, 2021). One type of thinking ability is creative thinking skills. Creative thinking skills are one of the goals that must be achieved in learning mathematics in schools. Creative thinking is a thinking process that produces various possible ideas and methods widely and diversely (McGregor, 2006).

Several research results show students' creative mathematical thinking skills in solving problems (M. Baidawi et al., 2019). The results of (Fardah, 2012) stated that the creative thinking patterns of students in the high category were 20% of the total number of students, the medium category was 33.33% and the low category was 46.67%. In addition, the results of research from (Irawan, 2021) stated that the creative thinking ability of students in mathematics was in the medium category as much as 5.88% and the low category as much as 94.12%. Based on the results of the study, it can be concluded that the creative thinking ability of students in

mathematics is mostly still in the low category. In class VIII B, there are also obstacles for students in creative thinking in mathematics in working on flat-sided spatial problems such as cubes and blocks. In working on cubes and blocks, more reasoning is needed to be able to solve the problem (M. Baidawi et al., 2016).

From the results of the pre-test or initial observation given by the researcher to students in VIII B, it show that their creative thinking ability in mathematics is low. Where there are still many students who answer questions according to existing examples and cannot develop their answers and students are still unable to find strategies in solving problems. Previously, the method or model used for learning mathematics in class VIII B students was the lecture method or teacher-centered method. Where the teacher delivers the lesson material directly to students. While many students are silent or passive during the learning process. If there are students who have difficulty understanding the material presented by the teacher, students tend to be afraid to ask and are embarrassed to express their opinions. This lecture method is often found in learning processes in schools from elementary to college level. If improvements are not made in learning, this will have a very bad impact on students' creative thinking skills. And that is the task of researchers to help teachers in fixing and improving students' creative mathematical thinking skills.

Meanwhile, to achieve success in improving creative mathematical thinking skills, students are required to be able to achieve and master creative thinking indicators, namely fluency, flexibility, and novelty(Taufiqurrahman &., Bagus, S. D., Adawiyah, F. R., 2022). Where fluency is producing something diverse. Flexibility itself refers to students' ability to provide solutions that are not usually done by individuals at their stage of development.

Therefore, one alternative or way to overcome this and improve students' creative mathematical thinking skills is through solving open-ended problems (Becker & Shimada, 1997). This is the opinion of (Silver, 1997) who put forward another way to measure mathematical creative thinking skills, namely with open-ended problems. Open-ended problem is an approach that presents an open problem that allows students to develop their mindset freely according to their interests and abilities so that it can provide students with the opportunity to gain knowledge, recognize, and solve problems with several techniques, and appreciate students when they find answers to the problems given and pay attention to students' cognitive differences (Taufik, 2014).

The researcher chose this open-ended problem-solving because students can answer each flat-sided geometric figure question with varying solutions so that students can think more

creatively, (M. Baidawi, 2006) and (M. R. I. E. A. J. Baidawi, 2020) This is also reinforced by research from (Saputro et al., 2023) entitled "Application of the Open-Ended Approach to Improve the Ability to Solve the Area of Irregular Flat Figures", from this study it was obtained that the open-ended approach can improve students' ability to solve the area of irregular flat figures and a positive response to mathematics learning.

RESEARCH METHODE

This research is a classroom action research (CAR). This research uses 4 stages, namely the planning stage, implementation stage, observation stage, and reflection stage (Ferrance, 2000). The subjects of this study were students of class VIII B, SMP Negeri 1 Prambon. The reason for taking the subjects was because they had received material on flat-sided cube and cuboid space structures and were not burdened with national exams. In addition, there were also reports from several class VIII mathematics teachers and the results of the pre-test that had been completed by class VIII B students. This study consisted of two cycles, namely the first cycle consisting of 3 meetings and the second cycle consisting of 2 meetings.

This study focuses on students' creative mathematical thinking skills in the form of LKS (Student Worksheet) instruments and individual test questions with indicators increasing if many students have higher creative mathematical thinking skills in each cycle than before. The data collected used a test method for each student. There are two types of tests given to students, namely pre-test and post-test. The purpose of the researcher in giving the pre-test is to determine the initial ability to what extent students understand the material to be studied containing basic cube and cuboid questions. Meanwhile, the researcher's purpose in providing post-test questions is to determine the level of students' understanding of the concept of cubes and cuboids as a reference for reflection to determine the next cycle of action. The first and second cycle post-tests contain questions on calculating the volume of cubes and cuboids but with different levels of difficulty between the questions in the first and second cycles. The pre-test is carried out once in the pre-action and the post-test at the end of the action of each cycle. The test is individual and the implementation time is adjusted to the mathematics lesson hours in class VIII B, SMP Negeri 1 Prambon - Sidoarjo. For the pre-test, the time is 1 lesson hour (40 minutes) and for the post-test, the time is 2 lesson hours (2x40 minutes).

RESULTS AND DISCUSSION

Changes in students' creative mathematical thinking abilities in each cycle can be seen in the following Table 1.

Table 1. Improving Students' Creative Thinking Abilities

Creative Thinking Skills	Many students have creative thinking skills		
	Initial Test	**Cycle I**	**Cycle II**
Understand Information	40.00 %	42,86%	44.08%
Fluency	-	50,52%	55,00%
Flexibility	-	21,00%	27,88%
Novelty	-	-	-

The following are some of the results of students' work in solving open-ended problems which are categorized as student work results with the creative thinking category in Figure 1.

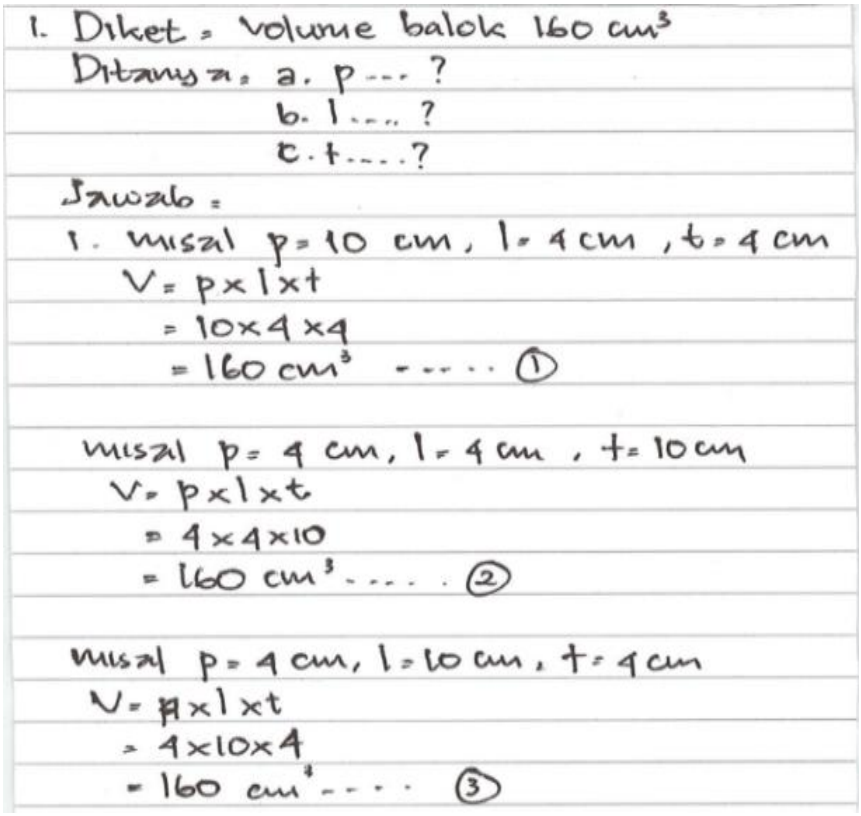

Figure 1. Student work results with creative thinking category

Figure 1 shows that students can understand the questions well. Students can estimate the volume of the cuboid well. They are also able to sequence the steps from the known stage, asked to the completion stage. Students are also able to complete and find as many as three alternative answers in different ways. The results of this work are categorized as creative students. This category includes indicators of fluency and flexibility only according to the

findings of (Baidawi, Mahardhika, et al., 2023). The results of students' work in solving open-ended problems which are categorized as students work with fairly creative thinking are shown in Figure 2 below.

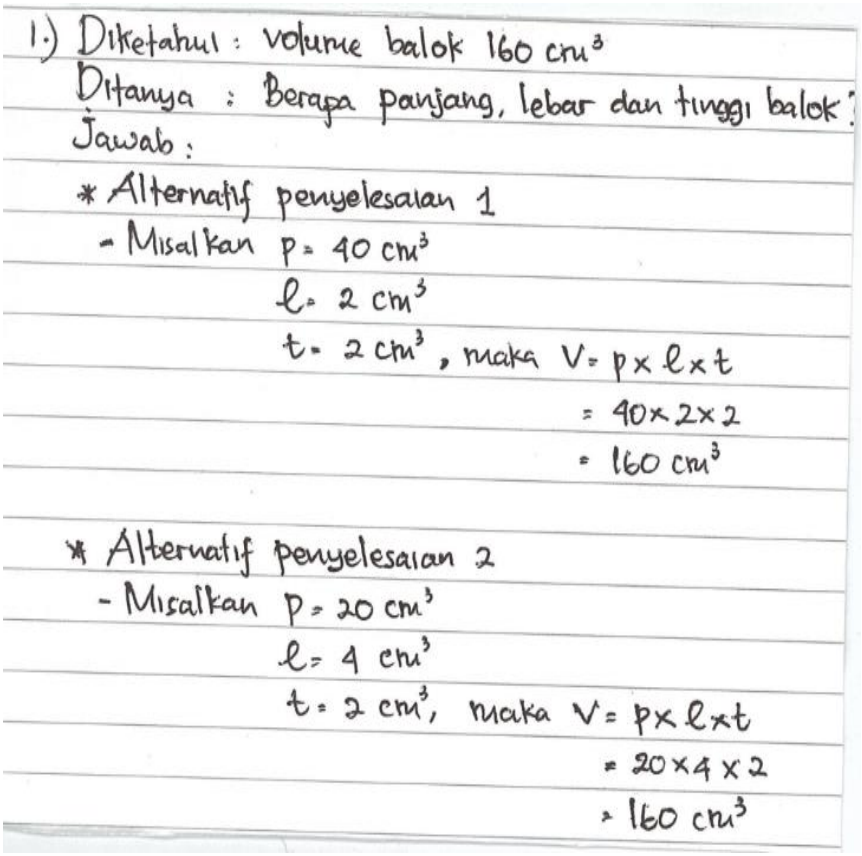

Figure 2. Student work results in the fairly creative category

In the second example of student work, the student is also seen to be able to estimate the problem quite well. The student is also able to sequence the steps of the work well and clearly. The difference with the first work is that in the first picture, the student can find three alternative answers. In the second picture of the work, the student can complete and find two alternative answers. This is because the question instructions require finding more than one answer. Students whose work results are like this are categorized as "Quite Creative" The results of students' work in solving open-ended problems that are categorized as students' work with the category of less creative creative thinking are shown in the following Figure 3.

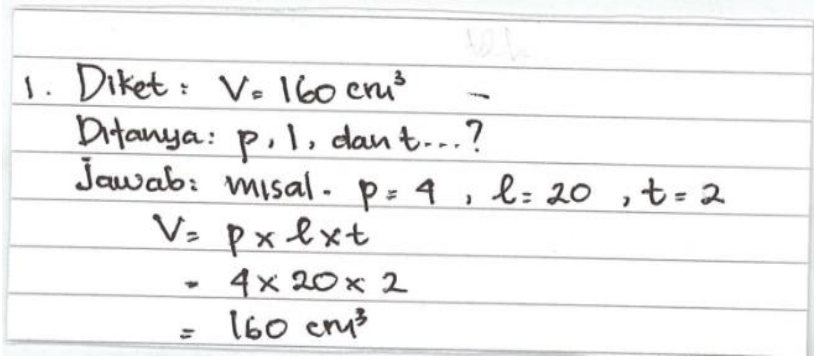

Figure 3. results of student work in the less creative category

In the picture or student work results above, it shows that students do not understand the instructions for the questions or maybe students have not been able to find or find answers or other alternative solutions. This shows that students' creative mathematical thinking skills are still in the "Less Creative" category. This category does not include the three achievement indicators, namely fluency, flexibility, and novelty.

In class VIII B, there are no students who deserve to be categorized as very creative in their mathematical thinking skills. And for the "Not Creative" category, this category is for students who are unable to answer questions or do not work on questions at all. Students only answer one question while the other questions are not worked on. In class VIII B, many students were found who still have uncreative thinking skills. This may be because many students are still unable to solve open-ended problems and are unable to understand the meaning of the question. This is the researcher's homework to find a solution so that students' creative mathematical thinking skills increase.

This research activity was carried out from cycle I to cycle II, the researcher found several incidents that were considered to be able to influence the research or cause and effect of the research, namely increasing students' creative mathematical thinking skills through solving open-ended problems. Before the implementation of open-ended problem-solving learning in class VIII B, students' problem-solving abilities were very lacking, which could affect students' low creative thinking. So many students' math scores have been below the KKM and every time a test or exam is held, many students have to retake so that their scores meet the KKM, which is 76. After the implementation of open-ended problem-solving learning in class VIII B, several students experienced an increase in their creative mathematical thinking abilities. This is by Livne's opinion that mathematical creative thinking refers to the ability to produce varied, new

solutions to open-ended mathematical problems (Asikin et al., 2019). Open-ended is interpreted as an open-ended question.

CONCLUSIONS AND RECOMMENDATIONS

Based on the description of the research implementation data and discussion, it can be concluded that class VIII B students experienced an increase in their mathematical creative thinking skills from cycle I to cycle II after implementing open-ended problem learning, namely from a low category in cycle I to a high category in cycle II. This shows that open-ended problems can improve students' mathematical creative thinking skills. Suggestions that can be given by the author after conducting the research are as follows, The researcher suggests that mathematics teachers at SMP Negeri 1 Prambon apply open-ended problems in their learning process. However, it is also necessary to select materials in implementing it such as flat shapes, spatial shapes, etc. In implementing open-ended problems, the researcher suggests that teachers making questions or open-ended problems must adjust to students' thinking abilities. The researcher suggests that open-ended problems can be interesting by letting students answer in their own way. To motivate students to learn through open-ended problems, the researcher first presents the simplest problems. This is so that students can solve problems easily through open-ended problems. The researcher also suggests making real teaching aids or authentic media in implementing open-ended problems if necessary.

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