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Analyzing Junior High School Students' Mathematical Creative Thinking Skill in Mathematical Modelling

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ABSTRACT

Creative thinking skills are one of the skills that must be developed in order to pursue developments in the 21st century. The development of creative thinking skills must be applied within a formal education level. One of the areas of study taught in formal education is mathematics. Mathematics can be used to solve problems in everyday life by using mathematical modeling. This study aimed to analyze the students' mathematical creative thinking skills in mathematical modeling with descriptive design. The steps on this research consisted of designing a test of creative thinking skills; Interviewed test results of mathematical creative thinking skills; and analyzed student answers results on mathematical creative thinking skills tests. The subject of the study consisted of 65 of junior high school students of class VIII. Findings demonstrate the skills of creative thinking students in modeling in the category of students with high mathematical abilities is that students can create unique models and seek solutions using different ways with logical and systematic, in medium category, students have a tendency to use trial and error methods as well as procedural ways to test models made, while in low category, students tend to use trial and error Test the model and resolve the problem.

Keywords: creative thinkings, mathematical modelling

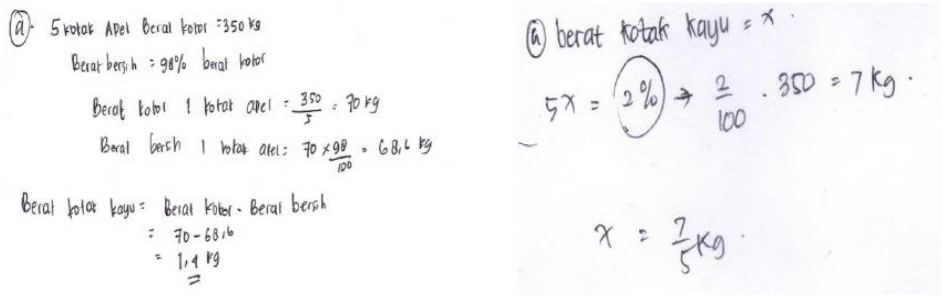
INTRODUCTION

Development of the quality of human resources in the 21st century must be a priority, so that a new formulation of competencies and skills is needed to face the industrial revolution in the 21st century and in order to prepare human resources who are ready to process natural resources in a modern way. The formulation of competencies and skills must be applied in the national education system which is one of the tools for us to develop potential [1][2][3][4][5]. One of the results of the 21st century skill formulation that is deemed necessary is creative thinking skills. The ability to think creatively mathematically follows two abilities namely convergent and divergent thinking that have characteristics including fluency of thinking, flexibility, and originality [6][7][8]

Development of creative thinking skills must be applied in formal education levels. One area of the study taught in formal education is mathematics. Mathematics learning is given to all students to equip them with the ability to think logically, analytically, systematically, critically, creatively, and be able to work together in solving problems and phenomena that occur in real life. In solving problems in everyday life mathematically it takes a process to transform information from the real world into the form of symbols, symbols and mathematical ideas. This process is called mathematical modeling.

Based on the results of research by Dan & Xie [9], mathematical modeling has a positive correlation with the ability to think creatively. Mathematical creative thinking skills can be developed through problem solving [10] while solving mathematical problems in a mathematical process is needed in the form of mathematical modeling called mathematical modeling. So that mathematical modeling itself can help identify how students' mathematical creative thinking abilities. The results of a preliminary study that researchers conducted to see the students' mathematical creative thinking abilities found that in working on the mathematical creative thinking abilities test, there were various mathematical models made by students in finding solutions to the problems given as seen in Figure 1. In Figure 1 (a) student A represents the solution to the problem tends to use the word representation in explaining the process of producing a solution. The ideas developed by student A in solving problems also tend to be systematic. Meanwhile

student B (Figure 1 (b)) tends to use more abstract representations such as splitting into a variable and using a different approach from student A.



(a) (b)

Figure 1. Examples of student answers for tests of mathematical creative thinking ability (a) student answers A (b) student answers B

The difference in mathematical models or the way they are represented by students is influenced by the level of mathematical ability (Sulastri, 2017). The implementation of school zoning regulations in Indonesia results in students 'mathematical abilities in each school tending to be diverse, so teachers need to choose learning models or strategies that are appropriate in developing students' mathematical abilities especially creative thinking abilities. To be able to determine the right learning strategy in developing mathematical creative thinking abilities, it is necessary to know the characteristics of students 'mathematical creative thinking abilities in each level of students' mathematical abilities, namely high, medium, and low. Based on the explanation above, the researcher wants to analyze the characteristics of students 'mathematical creative thinking abilities in mathematical modeling which is seen based on the level of students' mathematical abilities

METHOD

To analyzing junior high school students' mathematical creative thinking skill in mathematical modelling, we carried out a five-step of qualitative study involving 65 junior high school class VIII. First, we designed three word-problems to assess creative thinking skill. Second, we tested the problem to student of mathematics education program and then we interviewed the students about their solutions for the problem given. The test lasted for 90 minutes. Third, we divided the subject into 3 group, which are high, medium, and low mathematical achievement student. Fourth, we reduced the student in each group so that 2 students were chosen for each group. Finally, we analyzed student written work based on indicator of mathematical creative thinking skill.

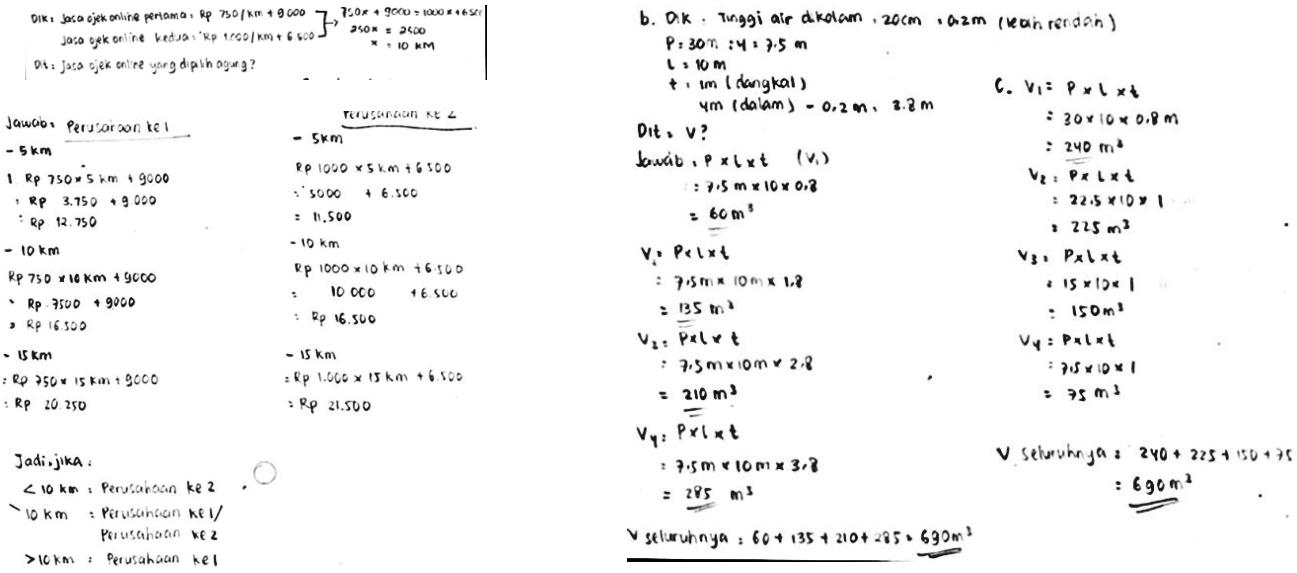
RESULT AND DISCUSSION

Table 1 summarizes results of junior high school student written work. The columns level mathematics means the numbers of student answer. According to Table 1. The results are that the junior high school student in level medium and low lacked of flexibility and originality in creative thinking. We reduce the data to be analyzed more deeply. For each category 2 students are chosen.

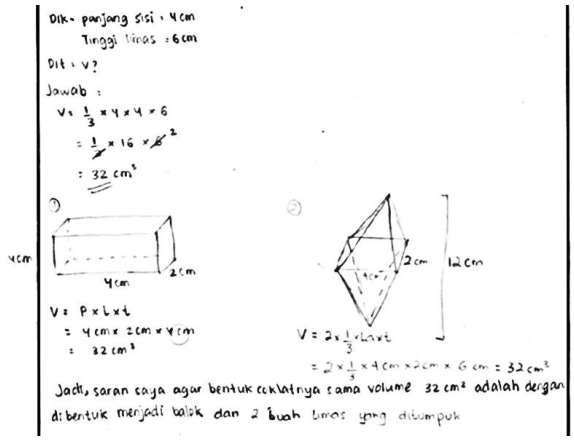
Table 1. Summary of student written work

No.	Indicator	Category	Level mathematics		
			High	Medium	Low
1	Fluency	Find a solution and correct	11	6	2
		Found a solution but wrong	3	6	8
		Did not find a solution	-	2	4
2	Flexibility	Find 2 ways to resolve and correct	7	3	-
		Find 1 solution and correct	6	8	7
		Did not find a solution	1	3	7
3	Originality	Find answers in unique ways	8	5	1
		Find answers to common ways	6	9	7
		Did not find a solution	-	-	6

Figure 2 shows students' answers in the high category. Based on the findings, students with high mathematical ability categories, researchers found that in the fluency aspect, students in the high category in parsing problems and building ideas (generating) tend to be systematic and detailed, mathematical models that have been built have been entered in the abstract stage, while in compiling a planning plan (planning) has a foundation or logical reasoning, deductive thinking and at the final stage always verifies the answers obtained (producing). In the aspect of flexibility (flexibility) students easily change their perspective in identifying problems (generating), can arrange more than one model in helping the solution so as to produce a variety of ways to approach and mathematical models. Can see patterns that might exist in a mathematical model. Mathematical models or formalization of a problem tend to use a variety of ways. In the aspect of originality (authenticity) this category can identify, see the relationship between information building ideas or mathematical models and solving unique problems. In general students in this category have been able to think vertically and laterally which according to De Bono [11] lateral thinking refers to the discovery of new clues in finding ideas while vertical thinking is faced with the development of ideas and examination of a criterion. Synthesis of 2 thoughts that produce creative thinking. Based on the three aspects of mathematical creative thinking stated above, students in the high category are at the level of constructive thinking [12][13].



(a) (b)

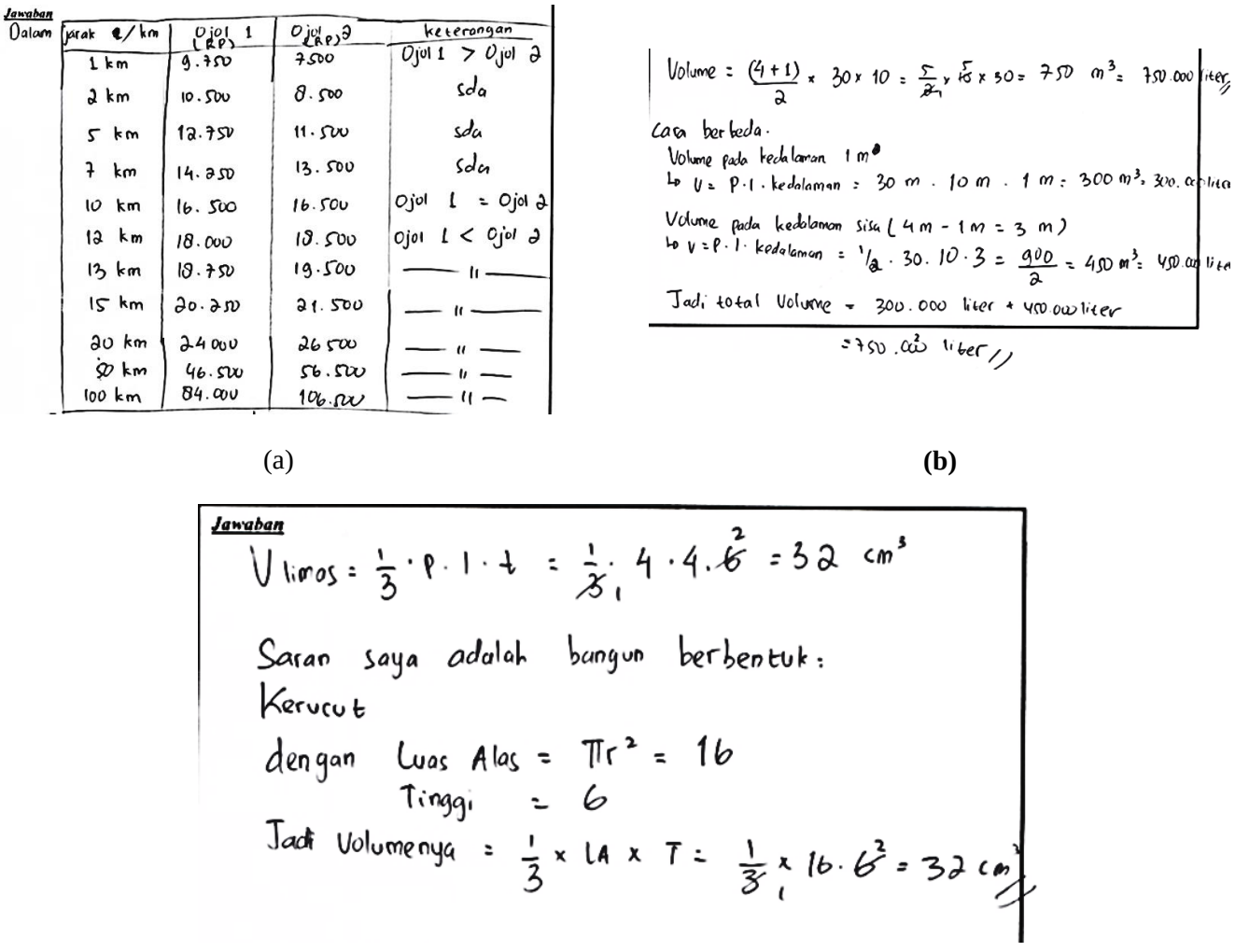


(c)

Figure 2. High category student test results. (a) fluency, (b) flexibility, (c) Originality

This is in line with Fardah [14] which revealed that students with high mathematical ability categories in the process of creative thinking have been able to understand the problem and can estimate the solution, then formulate and implement the plan and evaluate if there are obstacles in obtaining a solution. Students with this category can communicate their ideas both verbally and in writing clearly and coherently. While the results of creative thinking from students in the high category can provide various or various categories of responses and different ideas in detail and in full

Figure 3 shows students' answers in the medium category The findings in the aspect of fluency (fluency) students with medium category, in building models or mathematical ideas (generating) tend to use forms of representation or models that are simple (iconic) and not too much detail. It is rare to verify the final answer to a problem. In the aspect of flexibility (flexibility) in solving problems (producing) or formalizing mathematical models, students in the medium category sometimes have a little difficulty in changing their approaches to solving problems. Using trial and error methods when experiencing a deadlock in solving problems mathematically. In the aspect of originality, students in this category can see the connectedness of information or build mathematical representation in a unique way. In general, students in this category are at the algorithmic stage [12][13].



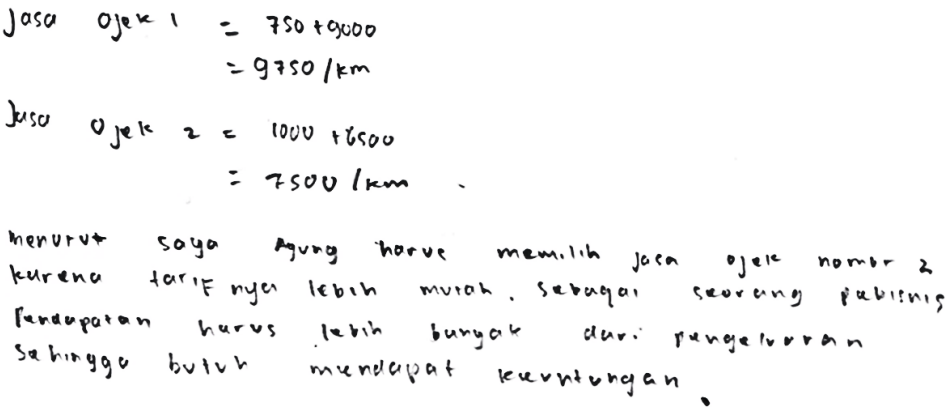
(a) **(b)**

(c)

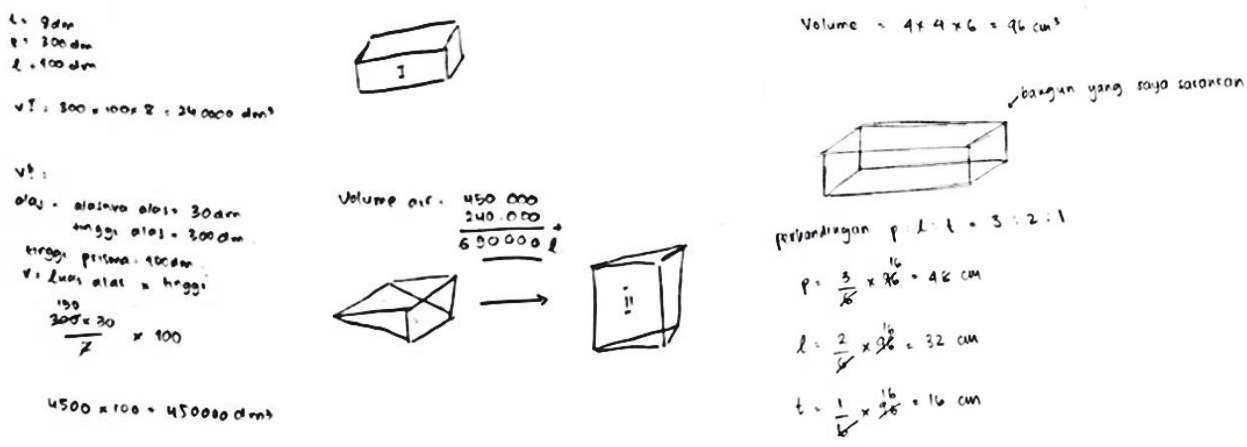
Figure 3. Medium category student test results. (a) fluency, (b) flexibility, (c) Originality

This is also in line with the results of Fardah [14] in the process of creative thinking students can understand the problem and can predict the solution, plan and implement the plan, but when they encounter obstacles in carrying out the plan they easily give up and even cancel the procedures they have arrange while the creative thinking products of this medium category are less varied in terms of responses, the categories and some of the responses are the same as other students. The results they provide are less detailed and complete

Figure 4. shows students' answers in the low category. Based on the findings, students with low mathematical ability categories, in the aspect of fluency (fluency) students with this category, in building mathematical models or ideas (generating) also tend to use forms of representation or models that are simple and not too much detail (iconic). It is rare to verify the final answer to a problem. In the aspect of flexibility (flexibility) in problem solving (producing) or formalization of mathematical models, students in this category sometimes tend to do trial and error methods in finding solutions to models that have been made or to problems that are new to them. The problems that have been found tend to use the methods that have been taught by teachers in schools and it is difficult to find other methods in solving mathematical models. In the aspect of originality, it is difficult to make unique mathematical models. In general students of this category are at the empirical stage [12][13]. This finding is in line with what was revealed by Fardah [14] where students find it difficult to understand the problem and estimate the solution. When they drafted their settlement plan.



(a)



(b) (c)

Figure 4. Low category student test results. (a) fluency, (b) flexibility, (c) Originality

CONCLUSION

From results describe in the previous section, we draw the following conclusions. Findings demonstrate the skills of creative thinking students in modeling in the category of students with high mathematical abilities is that students can create unique models and seek solutions using different ways with logical and systematic, in medium category, students have a tendency to use trial and error methods as well as procedural ways to test models made, while in low category, students tend to use trial and error Test the model and resolve the problem

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