



Mathematics creative thinking levels based on (learners')? habits of mind

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Abstract. Creative thinking is the ability to solve problems with various alternative ideas and solutions. One of the affective aspects of behavior that is contained in creative thinking is the habits of mind. The habits of mind can be defined as the actions or behavior in solving problems intelligently. This study aims to analyze the level of mathematics creative thinking ability based on the habits of mind. This research was conducted in the eighth grade of Junior High School in Sumedang. This is a descriptive study with qualitative approach. The data were collected through interviews, questionnaires and documentations. The results show that students who have high habits of mind are in the level 3 of creative thinking skill (creative). Students with moderate habits of mind are in the level 2 (creative enough). Meanwhile, the students with low habits of mind are in the level 0 (not creative).

1. Introduction

Mathematics is a science that very important and role in life to developing science and technology. Therefore, mathematics is taught from an early age from basic education to higher education so that students have mathematical abilities. The purpose of giving mathematics lessons is that students can logical thinking, analytical thinking, systematic thinking, critical and creative thinking skills and have the ability to cooperate in solving problems faced by the community, especially in the 21st century we are required to be able to compete globally, so that we need a capable ability one of them is the creative thinking ability [1].

Creative thinking skill is very important in problem solving and are the main factor for each individual to survive in global competition [2]. Creative thinking is processes of mental activity and habits of mind that are trained by paying attention to intuition and imagination so as to reveal new possibilities, open new perspectives and produce original new ideas in solving problems [3][4]. Solving mathematical problems requires the ability to record information creatively by using strategies, make mathematical models and modifying problems or objects with certain rules so that problems are easily solved, to do so needed creative thinking skills. However, the results



of the study show that students' creative thinking skills in problem solving are still relatively low, this is evidenced by the average score of skill indicators in finding problems including non-creative categories, skills in finding ideas including non-creative categories, and skills on finding solutions including the non-creative category [4]

There are four levels of mathematics creative thinking abilities, namely; Level four (very creative) Students are able to solve problems with more than one alternative answer, make different problems smoothly (fluency) and flexibly, and students are able to make a new answer (novelty) [5]. Level three (creative). Students are able to show new answers fluently, but can't show different ways (flexible) or can show different ways (flexible) even though the answer is not new. In addition, students can make different (new) problems smoothly even though the way to solve the problem is single or can create a variety of problems with different ways of solving, even though the problem is not new [5]. Level two (creative enough). Students are able to make a new answer or problem even though they are not flexible or fluent, or are able to show a variety of different solutions even though they are not fluent in answering or making problems and the answers produced are not new [5]. Level one (less creative) Students are not able to make answers or create new problems and cannot solve problems in different ways, but are able to answer or make diverse problems (fluent) [5]. Zero level (not creative). Students are unable to make alternative answers or ways of solving or making different problems fluently [5].

According to Puccio and Murdock affective behaviors contained in creative thinking include; feeling problems and opportunities, tolerant of uncertainty, flexible, curiosity, building self-confidence, meta-cognitive, understanding the environment and creativity of others [6]. Affective behavior on creative thinking it is contained in the aspects of habits of mind. In addition, in responding and finding solutions to problems it requires strong dispositions and intelligent behavior [6]. Furthermore, strong dispositions and intelligent behavior are called habits of mind [7]. Habits of mind are smart habits in thinking to solve a problem which is a combination of various skills, attitudes, cues and experiences [8]. Based on the results of the study showed that habits of mind have an impact on mathematical abilities by 40% [9]. Students who have good habits of mind will always think flexibly that is making and finding ways of solving in several different ways, always asking themselves (metacognitive), not satisfied with the results obtained (continuous learning). Furthermore, students who have good habits of mind then their thoughts will turn to active thinking [10]. So, habits of mind is one of the affective aspect is very important to support the ability to solve mathematical problems creatively. Students 'creative thinking ability will develop if in the learning process students are given several questions that have varied answers, have alternative answers and through giving instructions that encourage students to think to find connections with other ideas then students' creative ideas will emerge [11]. The creative thinking skills is the potential possessed by everyone who distinguishes it is level [12]. Therefore, this research will analyze mathematics creative thinking level based on habits of mind.



2. Method

The method used in this research is descriptive qualitative, which is to explain the mathematics creative thinking level based on habits of mind. This research was conducted in the eighth grade of a junior high school in Sumedang. Purposive random sampling technique is used to choose subjects in eighth grade. Give habits of minds questionnaire in the form of a Likert scale to 24 students. Based on the results, three students have been categorized into habits of mind, namely Student 1 (S1) are students who are high habits of mind, Student 2 (S2) are students who are moderate habits of mind and Students 3 (S3) are students who low habits of mind. Next is to determine the habits of mind categories of students [13] in table 1

No	Interval	Category
1		High
2		Moderate
3		Low

Label

- \bar{x} : Student's habits of mind in each respondent
- \bar{x} : Mean score of student's habits of mind in samples
- s : Standard deviation in samples

Furthermore, students were given a test in the form of mathematical creative thinking skills based on indicators of fluency, flexibility and novelty. the results of the tests were analyzed to determine the level of mathematical creative thinking abilities. Then, Students were interviewed to find out their mathematical creative thinking skills.

3. Result and Discussion

The purpose of this study was to analyze students' creative thinking mathematics abilities based on habits of mind. Determining the habits of mind category comes from the questionnaire that has been given to students before the creative thinking ability test is conducted. Based on the results obtained score mean that students habits of mind is high category (S1), score mean that students habits of mind is moderate category (S2) and score mean that students habits of mind is low category (S3). The results of the answers to students' creative thinking abilities of mathematics from three categories are analyzed, then students are interviewed about what has been done on the answer sheet. The following are the results of the analysis of the answer sheets and interviews with students.

Analysis of student with high habits of mind (S1)

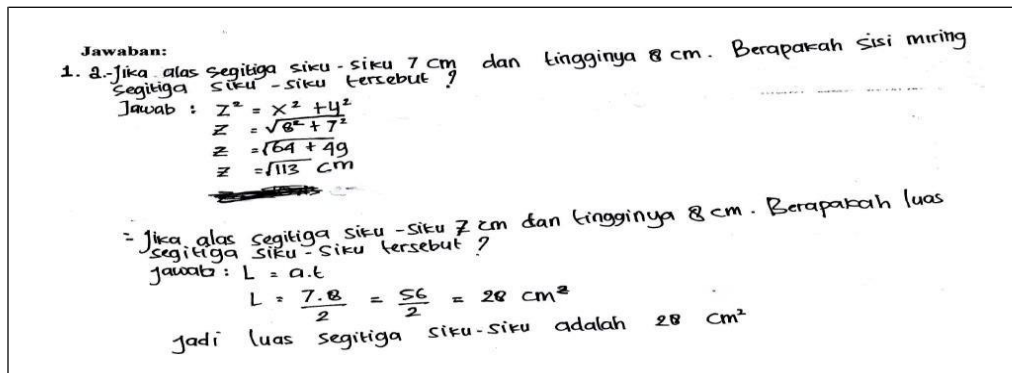


Figure 1. S1 Answer for test number 1

Based on the results of the S1 answers above, S1 can make two different questions, namely making questions about how long the hypotenuse of a right triangle and the question about the area of the triangle that has known the base and height along with the correct answer but there are few mistakes in writing the triangle formula but the answer is still correct. This means that S1 has understood the problem, so that it has produced several different questions accompanied by answers (Flexibility) and smooth in solving problems (fluency).

Based on the results of interviews, S1 easily and smoothly makes questions (fluency) related to number one questions based on the concepts that have been taught, but makes the question only relate to the area, circumference and determine the length of the side of the third triangle that is unknown. When S1 is given a question can you make a another question than the three questions it (area, circumference and length of the triangle), S1 cannot answer it. This means that the ability of S1 in the originality aspect is still low.

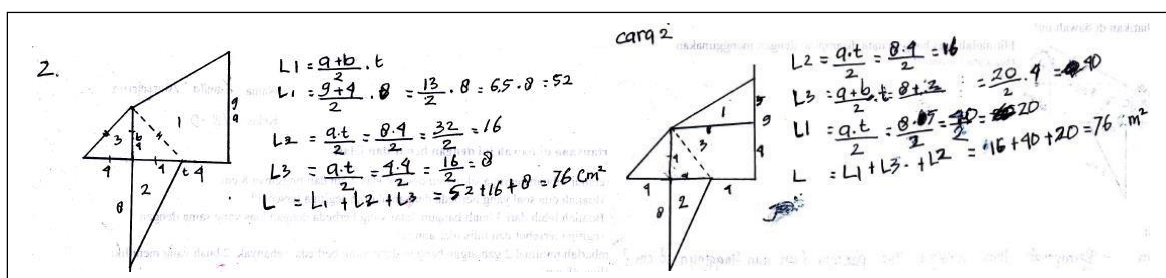


Figure 2. S1 Answer for test number 2

Figure 2 shows that S1 is able to solve problems with two different alternative solutions (Flexibility) in accordance with test instructions. The first method S1 makes a support line to divide the field into three two-dimensional figure parts, namely: first is a trapezoid, the second is a triangle and the third is a right triangle. Then S1 specifies the third size of the flat building and calculates it correctly even though there is mischief during the calculation process (not fluent) it can be seen from the streaks on the answer sheet. The same thing is done in the way of 2 that distinguishes it is to make the support line.

Based on the results of the interview, S1 can explain the concept of the answer he wrote in mway of 1 and way of 2 smoothly and correctly. When asked why the answer is method 2 there are many streaks. Then S1 answers that the previous completion of method 2 is different from method 1 due to an error when specifying the size of the two-dimensional figure wake made, after checking the size written on the trapezoid is wrong, then S1 calculates again and the result is the same way of 1. S1 has also learned to finish similar problem like that.

Based on the results of the analysis of answers and interviews, it was found that the ability to think creatively in S1 at level 3 (creative). This is consistent with Siswono that students at level 3 (creative) can show different ways (flexibility) to get diverse answers even though they are not new and can solve various problems with different ways of solving, even though the problem is not new (not novelty) [5].

Analysis of student with moderate habits of mind (S2)

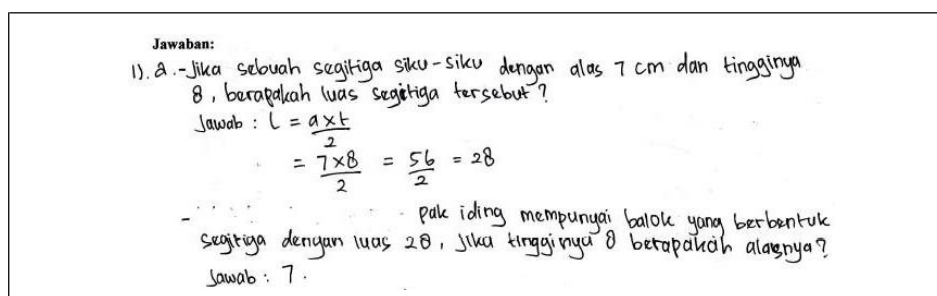
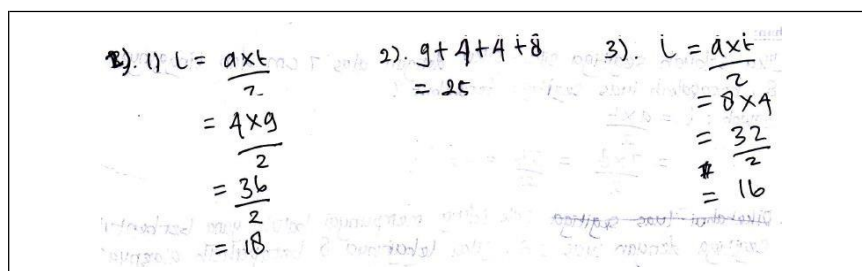


Figure 3. S2 Answer for test number 1

Based on the figure of the answer above, S2 made two different questions. First, the question of the area of a triangle is accompanied by its completion correctly and fluently but does not use a unit of area. Second, S2 makes unclear questions and the concept of questions that are not different from the first question and are not accompanied by a solution (not flexible).

Based on the results of the interview, S2 could explain the first question accompanied by its completion smoothly, but could not make a different second question. When given a question whether the hypotenuse of the triangle can be adjusted, S2 answers it can, but S2 cannot do it and does not know the formula.



1). $L = \frac{a \times t}{2}$
 $= \frac{4 \times 9}{2}$
 $= \frac{36}{2}$
 $= 18$

2). $9 + 4 + 4 + 8$
 $= 25$

3). $L = \frac{a \times t}{2}$
 $= \frac{8 \times 4}{2}$
 $= \frac{32}{2}$
 $= 16$

Figure 4. S2 Answer for test number 2

Based on the results of the answer in question number 2, S2 does not divide the flat building into several forms of other two-dimensional figure shape by making an auxiliary line and but S2 tries to divide the area of the triangle contained in the problem but does not calculate the area. Here it is seen that students lack of understanding about calculating the area of flat up in the problem and lack of understanding of regular rectangular shapes. Students are not fluent in making completion of ways 1 and S2 cannot make alternative answers (not flexible)

Based on the results of the interview, it was found that the S2 felt confused and had difficulty in calculating the existing area in question because the shape of the building was irregular. But when asked why he did not use the help line in solving the problem, S2 answered that he had thought about this but two-dimensional figure it was difficult to use the support line and S2 had worked on a problem like this before.

Based on the results of the analysis of answers and interviews with S2, it was concluded that S2 creative thinking skills at level 2 (quite creative). Students are able to make one answer or problem that is different from the usual although not fluent or flexible and does not produce new answers, then students are at level 2 (creative enough) [5].

Analysis of student with low habits of mind (S3)

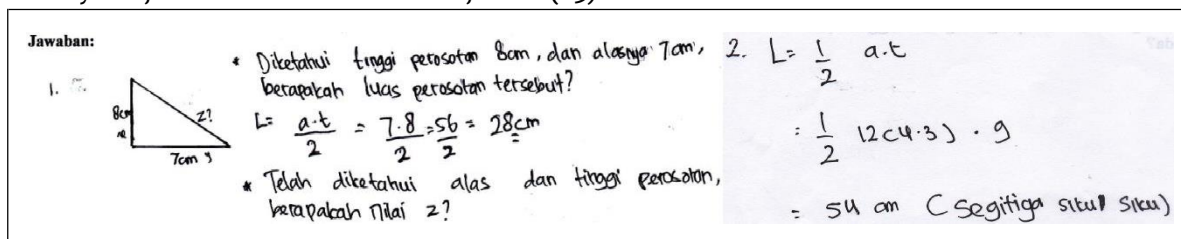


Figure 5. S3 Answer for test number 1 and 2

In figure 5, S3 answers test number 1 by making two questions. First, make a question absurd, but S3 understands the area concept of triangles and makes alternative solutions correct. Second, make questions related to the hypotenuse of the triangle but students do not make alternative solutions, this means students do not know the formula used to calculate the hypotenuse of a triangle. In question number two, S3 immediately solution without drawing and divides the flat building into several parts and S3 does not clearly solutions it and do not make other alternative solutions. So S3 does not have experience in solving problems and don't understand the concept of triangles and quadrilaterals.

Furthermore, the results of interviews with S3 on question number 1 were obtained that S3 did not understand the concept of a triangle, S3 did not make a solution to the problem he had made, because he forgot the formula Pythagoras (not fluent and less flexible), and S3 was also unable to make new questions different than the one written (not novelty). In question number two, the S3 did not understand how to calculate the area in the picture in question number two because the shape was different from usual. S3 also did not think about dividing the two-dimensional figure building into several parts and the S3 could not find a way to calculate the area in question number two. Based on this, S3 does not have flexibility aspects because S3 rarely works on math problems.

Based on the results of the analysis of answers and interviews it can be concluded that S3 not able to make alternative answers or do not solve the problem smoothly (fluency), do not have other alternative answers (Flexibility) and do not make new answers (novelty) then, mathematics creative thinking ability is level 0 (not creative). Students are not able to make alternative answers or ways to solve or make different problems fluently and flexibly, mathematics creative thinking skills student is not creative (level 0) [5].

4. Conclusion

Based on the results of the analysis and discussion, the students' mathematics creative thinking level based on habits of mind of grade VIII are: 1) Students who have high habits of mind are in the level 3 of creative thinking skill (creative), 2) Students with moderate habits of mind are in the level 2 (creative enough), 3) Students with low habits of mind are in the level 0 (not creative). There is a positive relationship between habits of mind and creative thinking. Students who have good habits of mind, their ability to think creatively will also be good [14]. Habit of mind has a



considerable impact on mathematical abilities because in solving mathematical problems students will think intelligently [7] [9]. In order for students 'creative thinking skills to increase, the learning process must require students to think so that students' habits of mind abilities develop.

5. Acknowledgments

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6. References

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