The Students' Creative Thinking Ability to Solve Mathematics Problem based on Siswono's Creative Thinking Classification

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Abstract. Creative thinking ability is the ability to build new ideas based on non-routine problems that must be solved. Characteristics of creative thinking that is fluency, flexibility and novelty. Siswono classifies students' creative thinking abilities into 5 levels with each characteristic. The aim of this study is to describe each levels of students' creative thinking abilities in solving mathematical problems based on Siswono's classification. The research used descriptive qualitative method. The subjects in this study were 5 students of class VIII at junior high school 02 Sutojayan in academic year 2018/2019 with each level of creative thinking according to Siswono. The results showed that students with level 0 could not meet the criteria of creative thinking, students with level 1 only met fluency criteria, students with level 2 only met the flexibility criteria, students with level 3 met the criteria of fluency and flexibility, while students with level 4 met the third criteria for creative thinking.

Keywords: Creative Thinking, Problem Solving, Siswono's Classification

1 Introduction

In the 21st century, the development of the industry is very rapid. The development of the industry currently entering in industry 4.0 that requires students to develop their own potential, one of them is in the field of education. The potential of students' can be developed based on lessons learned at school. The potential of students' such as critical thinking, problem solving, communication, collaboration, and information and communication technology (ICT) literacy are essential to succeed in their life [1], [2]. One of the subjects that can develop the potential of students is Mathematics. Mathematics is a symbolic language where everyone who studies mathematics is required to have the ability to communicate using that symbolic language. In its application, the resolution of mathematical problems by students is still low. This can be seen based on the results of the national test scores and Indonesia's ranking in the international competition organized by the PISA (Program for International Students Assessment). According to the Ministry of Education and Culture (2015) regarding the conclusions of the results of the Indonesian assessment, the measurement of student achievement based on the national test was in line with the achievements of PISA and TIMSS [3]. One of the abilities needed in both PISA and TIMSS assessments is the students' creative thinking ability. Students' creative thinking ability are the abilities students have in solving non-routine problems in a variety of ways. The aim of this study was to

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describe students' creative thinking abilities in solving mathematical problems based on Siswono's classification.

Problem solving is a basic activity that is often done by someone. According to In'am [4] and Solso [5], problem solving is an abstract and complicated process and involves human thinking and reasoning to find a solution for a specific problem. Polya describe that problem solving is the effort to find a solution of a difficult problems to achieve goals that cannot be achieved directly [6]. In mathematics, problem solving is an important skill of students have to solve problems [7]. Learning mathematics means learning about solving problems in the form of everyday problems and mathematical problems [8], [9].

Creative and critical thinking is generally regarded as a thought process that involves the skills and independent disposition to build new ideas that are triggered by problems that are not routine and challenging [10]. The problems called non routine because to solve the problem, students must use the generate new ideas so the students must have creative thinking ability [11], [12]. Creativity is an important aspect in the modern-day work setting to create something new or create a useful new idea [13]. By having the creative thinking ability, humans can develop their potential talents and can see problems based on various aspects [14].

The process of creative thinking involves synthesizing ideas, building an idea, then planning the application of ideas and applying those ideas to solve problems [15]. Creative thinking is closely related to problem solving because it is to determine the ability to solve the problems creatively [16]. Indicators for assessing students' creative thinking abilities are based on criteria of fluency, flexibility and novelty through problem solving [17]. These three criteria are explained in the table below:

Table 1. Indicators of creative thinking according to silver

Indicators	Explanation
Fluency	The fluency of students in solving mathematical problems is determined based on students' ability to solve more than one answer to a given problem.
Flexibility	The flexibility of students in solving mathematical problems is determined based on students' ability to use various ways in solving given problems.
Novelty	The novelty of students in solving mathematical problems is determined based on students' ability to use different ways of solving and more than one answer in solving problems.

Indicators of creative thinking according to Silver above are used by experts in classifying the level of individual creative thinking. The classifies level of creative thinking in solving mathematical problems into five levels, namely: Level 4 (Very Creative), Level 3 (Creative), Level 2 (Quite Creative), Level 1 (Almost Not Creative), Level 0 (Not Creative) [18]. There are levels of creative thinking was used in this study. For more clearly the level of creative thinking according Siswono, can be seen in the relation between the level of creative thinking with indicators of each level is stated in the table below:

Table 2. Relation between the level of creative thinking with indicators of creative thinking

Creative Thinking Levels	Indicators of Creative Thinking		
	Fluency	Flexibility	Novelty
Level 4 (Very Creative)	√	√	√
Level 3 (Creative)	√	-	√
Level 2 (Quite Creative)	√	√	-
	-	-	√
Level 1 (Almost Not Creative)	-	√	-
Level 0 (Not Creative)	√	-	-
	-	-	-

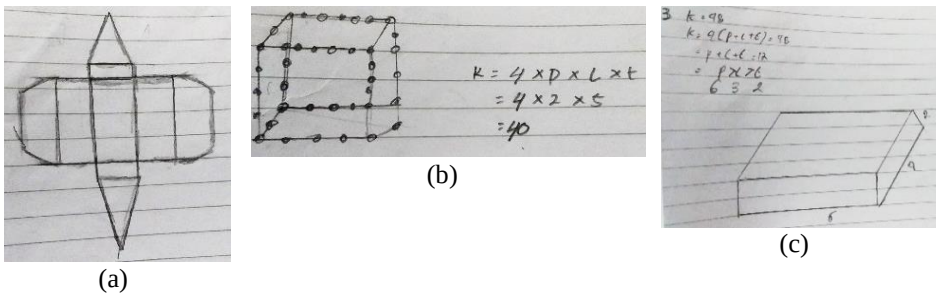
2 Method

This type of research used by researchers is descriptive qualitative. This research uses a case study research strategy. The focus of this research is on one phenomenon that is chosen and understood by ignoring other phenomena. The phenomenon chosen and understood is the students' creative thinking abilities in solving mathematical problems.

The subjects in this study were students of class VIII Junior High School Sutojayan which were then sampled as many as 30 students. Then the students given a test in the form of questions to know the creative thinking ability. Subject selection technique with the snow ball method.

3 Result and Discussion

The test is given to 30 students with 40 minutes of time work. The form of the problem, aims to find out: number 1 fluency, number 2 novelty, and number 3 flexibility of students in solving mathematical problems. The results of creative thinking tests given to 30 students of class VIII show that there are 4 students in L0 (not creative), 9 students in L1 (less creative), 7 students in L2 (quite creative), 6 students in L3 (creative) and 4 students on L4 (very creative). From these results one student is taken randomly from each level of creative thinking to find out the form of student answers. Students with each level are given initials, namely: not creative (SL0), less creative (SL1), quite creative (SL2), creative (SL3), and very creative (SL4). The results of the answers based on each level of students' creative thinking are as follows:



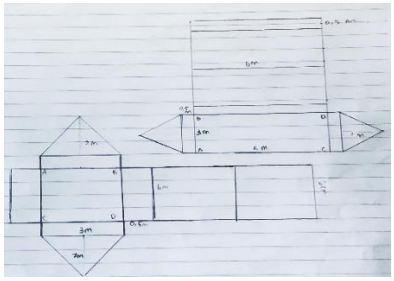
(a) (b) (c)

Fig. 1. SL0's answer to (a) problem number 1, (b) problem number 2 and (c) problem number 3

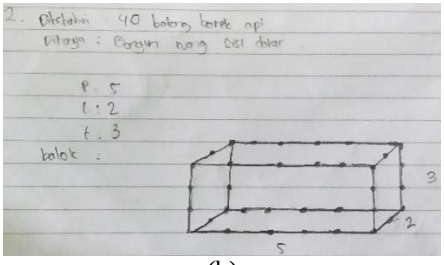
In **Figure 1.** (a) it appears that SL0 does not understand the form of the picture in the problem. SL0 does not include the length of each side, so the results of the answers do not match with the answers requested. The answer given is only 1 form. Based on the results, SL0 is still unable to show fluency in solving problems.SL0's answer to question number 2 is still not appropriate.

In **Figure 1.** (b) it appears that SL0 wrong to write the formula of the rectangle and incorrectly wrote the length, width and height value of the rectangle. SL0 only describes 1 form that does not show the uniqueness of the answers. Based on these results SL0 is still unable to show novelty in solving problems.

In **Figure 1.** (c) it appears that SL0 has not been able to draw the correct rectangle. The formula written is wrong so the answer written is also wrong. SL0 only describes 1 form. This shows that SL0 is not able to show flexibility in solving problems.



(a)



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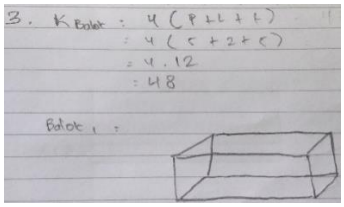


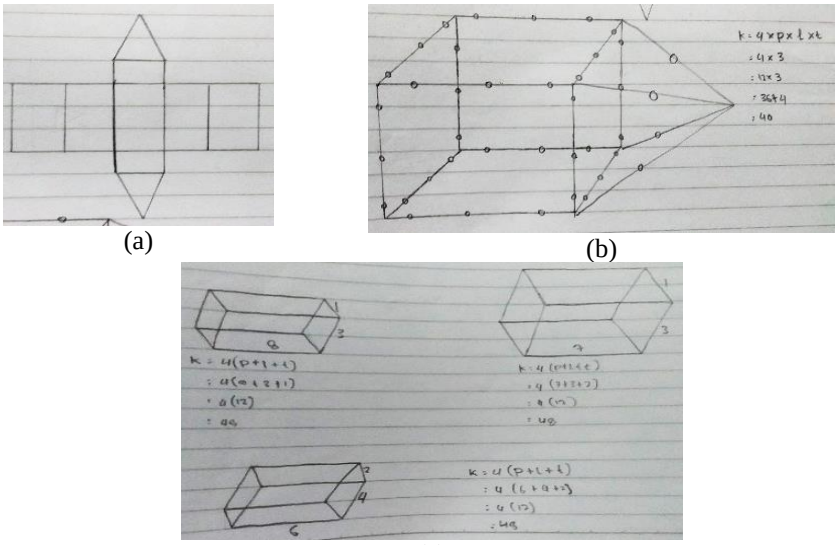
(c)

Fig. 2. SL1's answer to (a) problem number 1, (b) problem number 2 and (c) problem number 3

The answer of SL1 in **Figure 2.** (a) it appears that SL1 is able to describe the net from the problem. SL1 writes the length of each side and describes 2 forms of nets. Based on these answers, SL1 is able to show fluency in solving problems.

In **Figure 2.** (b), SL1 writes the value of the length, width and height of the beam. Based on the value of each side written, SL1 is able to describe correctly. However, the shape of the spatial structure depicted SL1 does not show uniqueness and SL1 only describes 1 form of answer. The results written by SL1 show no novelty in solving problems.

In **Figure 2.** (c), SL1's answers do not match the problem. SL1 is still wrong in determining the value of the length, width and height of cuboid that not match with the conditions of the problem. In the figure also shows that SL1 does not write the value of each side and only describes one form. From these results, SL1 was unable to show flexibility in solving problems.



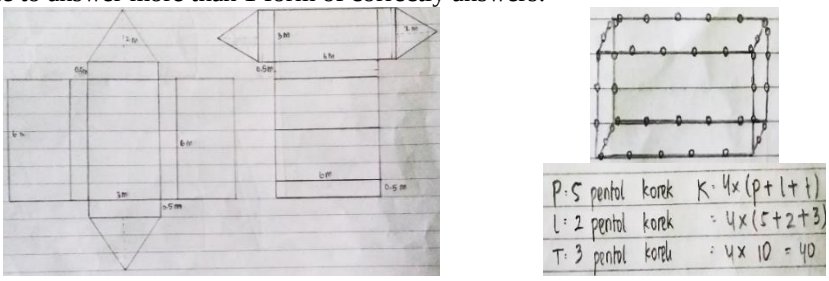
(a) (b) (c)

Fig. 3. SL2's answer to (a) problem number 1, (b) problem number 2 and (c) problem number 3

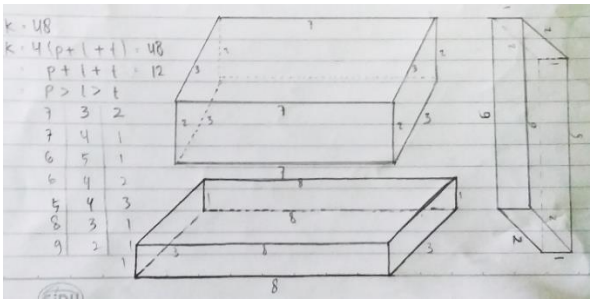
In **Figure 3.** (a) it appears that SL2 is able to describe the requested shape, but the picture is not equipped with the value of each side so the picture written by SL2 does not match with the problem. SL2 only describes 1 form of wrong answer. That means SL2 is still not able to show fluency in solving problems.

The answer of SL2 in **Figure 3.** (b) shows that SL2 is able to describe a unique shape of space with the right results of the problem, but the formula that written by SL2 is wrong and the numbers that written are also wrong. These results indicate that SL2 is still not able to show novelty in solving problems because the answers are wrong and only write one form of answer.

Figure 3. (c) is SL2's answer which shows that SL2 is able to write the answer correctly. SL2 is able to write the formula and the value of length, width, height as requested in the problem. Based on this result, SL2 has been able to show flexibility in solving mathematical problems because it is able to write the value of each side and be able to answer more than 1 form of correctly answers.



(a) (b)



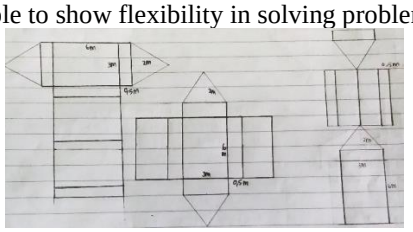
(c)

Fig. 4. SL3's answer to (a) problem number 1, (b) problem number 2 and (c) problem number 3

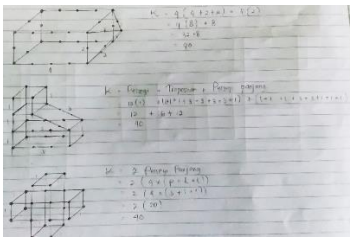
The answer that written by SL3 in **Figure 4.** (a) in the form of 2 different forms of nets. Both of the nets are equipped with the value of each side correctly. SL3's answers show fluency in solving problems because SL3 is able to describe more than 1 form of the answers correctly and appropriate with the problem.

In **Figure 4.** (b), SL3 write down the value of length, width and height of the cuboid arranged from the matchs. The value of each side of the cuboid is correct, so the value of the circumference of the cuboid matches with the problem. However, SL3 only describes 1 form and does not show the uniqueness of the answers. Based on these results, SL3 has not been able to show novelty in solving problems.

In **Figure 4.** (c) it appears that SL3 is able to write down the length, width and height value of the requested rectangle. SL3 is also able to describe the requested rectangular shape according to the length, width and height value of the rectangle. The answers that written by SL3 are more than 1 answer form and are equipped with writing length, width and height values in the picture. Based on these results, SL3 is able to show flexibility in solving problems.



(a)



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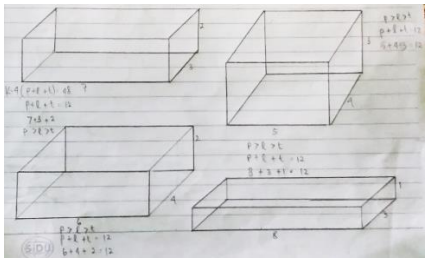

(c)

Fig. 5. SL4's answer to (a) problem number 1, (b) problem number 2 and (c) problem number 3

The answer that written by SL4 in **Figure 5.** (a) shows that students have understood the questions. Students are able to describe the shape of the requested of space by writing the length of each side of the space. SL4 is also able to depict more

than 1 image correctly. Based on these answers, SL4 has shown fluency in solving problems.

In **Figure 5.** (b) it appears that SL4 is able to describe the unique shape which is a combination of several shapes. The answers written in SL4 are also complete with the way to work down and resolved correctly. SL4 is able to describe more than 1 unique answer form correctly. These results indicate that SL4 is able to show novelty in solving problems.

SL4 answers on **Figure 5.** (c) shows that students are able to write the answers requested and are able to describe the results correctly. SL4 is complete in writing the answers by showing the length of each side requested correctly. The answers written and illustrated by SL4 also take more than 1 form. Based on these answers, SL4 is able to show flexibility in solving problems.

Based on the answers from each student shows that at each level of creative thinking:

1. Students with level 0 have not meet the criteria of flexibility, fluency and novelty in solving problems.
2. Students with level 1 only meet the criteria of fluency in solving problems
3. Students with level 2 only meet the criteria of flexibility in solving problems. However, there are no students who only meet the criteria of novelty in solving problems
4. Students with level 3 meet the criteria of fluency and flexibility in solving problems. However, there are no students at level 3 who meet the criteria of fluency and novelty in solving problems.
5. Students with level 4 meet the criteria of fluency, flexibility and novelty in solving problems.

That is compatible with the statement that students at a very creative level have good skills in problem solving [19]. This result same with Wahyudi and Dariman results in their research that novelty is a criteria of creative thinking ability that are still low [20], [21]. The criteria for novelty students are low because many students still have difficulty in determining new things in solving problems. students also still have difficulty in understanding the problem so some students have not demonstrated the ability to think creatively well.

4 Conclusion

The results showed that students with level 0 could not meet the criteria of creative thinking, students with level 1 only met fluency criteria, students with level 2 only met the flexibility criteria, students with level 3 met the criteria of fluency and flexibility, while students with level 4 met the third criteria for creative thinking. Beside the students with a very creative level of thinking, no student is able to demonstrate the criteria for novelty in solving problems. This result shows that the ability of students to show novelty in creative thinking is still low. Based on these results, it is important for learners to develop students 'abilities in determining novelty in solving problems so the students' creative thinking abilities can be improved.

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