Creative thinking level of students with high capability in relations and functions by problem-based learning

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Abstract. This research was conducted in order to describe the creative thinking level of students with high capability in relations and functions with Problem Based Learning. The subjects of the research were students with high capability grade VIII at SMPIT Ibnu Abbas Klaten. This research is an qualitative descriptive research. The data were collected using observation, tests and interviews. The result showed that the creative thinking level of students with high capability in relations and functions by Problem Based Learning was at level 4 or very creative because students were able to demonstrate fluency, flexibility, and novelty.

1. Introduction
Creative thinking skills is the skills to think of many possibilities; to use various methods; to use different point of view; to think of something new and innovative in order to guide the teachers in generating and selecting alternatives [1]. Creative thinking skills should be practiced at all levels of education from primary schools to universities to achieve the goals in accordance with the demands of the educational curriculum [1]. One of the abilities of mathematical thinking that needs to be developed early on is the ability to think creatively [2]. Therefore, the ability and creative thinking skills must also be owned by every student in the mathematics learning [3]. Hopefully, their creative thinking skills can be used to problems in daily life.

There are three main indicators of creative thinking skills, namely fluency, flexibility, and novelty [4]. Fluency in problem-solving refers to a student’s ability to obtain many solutions to a problem. Flexibility in problem-solving refers to a student’s ability to solve a problem using many different methods or ways. Novelty in problem-solving refers to the student’s ability to solve a problem with many different solutions and correct answers, especially to find an original solution which is not common for that student’s grades or their knowledge level. There are five creative thinking levels, namely level 4, level 3, level 2, level 1, level 0 [4]. Students at level 4 (very creative) satisfied three components of creative thinking indicators (fluency, flexibility, and novelty). Students at level 3 (creative) satisfied two components, flexibility and fluency or novelty. Students at level 2 (quite creative) only satisfied one aspect, namely flexibility or novelty. Students at level 1 (almost not creative) only satisfied a fluency aspect. Students at level 0 (not creative) did not satisfy all components.

The low ability of student’s creative thinking was described by some international research results such as TIMMS and PISA scores in recent years [5]. Then, the preliminary study of Carni [6] in one Senior High School in Bandung shows the result of the creative thinking tests that are given is in the
amount of 32.5, is still very low. The result is triggered by five main factors: (1) learning process is still informative; (2) learning is still dependent on the teacher; (3) learning is a memorizing activity; (4) teachers rarely practicing the comprehension ability; (5) teachers rarely practicing some experiment activities, and learning of physics is still the focus on the count [6]. The results of Dyers, J. H. that 2/3 of the ability of one's creativity obtained through education, 1/3 students come from genetic. These findings confirm the important role of education in developing creativity [7].

Based on the description that has been described, teacher must design learning that can develop creative thinking level. Currently the development is applied by changing curriculum of 2006 into the curriculum of 2013. This new curriculum were built based-on understanding of the competence to be achieved in the learning process and realizing the importance of being trained for high-level thinking skills[8]. In the curriculum of 2013 provides guidance for teachers to be more creative in teaching and developing teaching materials. Teachers are not the main actors but as facilitators, moderators, and evaluators in learning.

Problem-based learning is a method applied in Curriculum 2013 [9]. Problem-based learning can encourage students to actively solve problems so they can get the concept of the material independent [10]. One of the characteristics of problem-based learning is to provide a problem that close to real life and may occur in real life, so that Problem-based learning is a solution to facilitate the students to perform connection process between the material to real life [11]. Characteristics or traits problem based learning as follows: (1) the learning process should begin with a problem which is predominantly concrete problems; (2) materials and learning activities should pay attention to the circumstances of how that can attract the attention of students; (3) The teacher is a supervisor during the learning process; (4) students need to be given enough time to think or collect information and develop strategies for problem-solving and creativity they have driven while learning; (5) the level of difficulty of the materials studied are not at high rates which can make students despair; (6) the learning environment comfortable, quiet and safe should be constructed so that developing students' ability to think and solve problems [12].

Based on the description that has been presented, problem-based learning pay attention creative thinking skills. Kamin [13] say that problem based learning one of the teaching methods, has positive effects in the development of creative thinking skills. Problem-based learning model means gives a positive effect on students' creative thinking skills [14]. Problem-based learning can be applied to develop creativity well [15]. Learning by PBL can improve several skills, including communication skills, and the organization through team work [16]. The purpose of this research is to describe creative thinking level of students with high capability after mathematics learning by Problem-based learning. Students with high capability are chosen in order to become one of references by students with average or low capability.

2. Methods
This research is an qualitative descriptive research. Subjects in this study were students with high capability grade VIII at SMPIT Ibnu Abbas Klaten. To determine students with high capability, 36 students grade VIIIB-4 at SMPIT Ibnu Abbas Klaten were asked to solve problems about coordinate system. Coordinate system is the prerequisite material of the relation and function. The results of the test were rated using scores from 0-100, and they were grouped into three categories. The test scores ≤ 60 are categorized into low capability, 60 ≤ test scores < 80 into middle, and test scores ≥ 80 into high. Then students with high capability and good communication skills were chosen to be the subject of the study. The data were obtained using observation, test, and interviews. Observation used to obtain the quality of learning using problem-based learning. Test used to obtain data creative thinking skills. Interview used to clarify the student answer.

3. Result and Discussion
Observation on this research is observation of mathematics learning process conducted in class VIIIB-4 SMPIT Ibnu Abbas Klaten. The study material is the relation and function. Students who learn to
use the models of problem-based learning as participant is 36 students. Students are grouped into 9 groups, each group consists of four students. Each group given student activity sheet about relations and functions. Each group worked on the student activity sheet, then the results of the work presented in the class.

After learning relations and functions by problem-based learning, students solved mathematical problems to determine about their creative thinking skills. Students with high capability were selected as informants. According to test and interview result, creative thinking skills will be known as indicator that fulfilled by students with high capability. Then creative thinking level of student can be inferred.

Figure 1 showed that from the result of student's answer, the student can mention 5 ideas that is the function from A to B with the rule added by 1, the function from A to B with rule multiplied by 2, the function from A to B with rule multiplied by 6 then divided by 3, From A to B with rules added by 3, functions from A to B with rules added by 2. So students were able to apply ideas to solve problems. Based on the indicator of creative thinking skills, test result and interview result, it can be considered that the student fulfilled the fluency aspect in solving the problem.
Figure 2. Students answer sheet with sequential pairs way

Figures 1 and Figure 2 showed that the results of student answers, obtained by students can mention 2 ways to solve the problem that is the arrow diagram way and the sequential pairs way. So students were able to solve the problem in several ways. Based on the indicator of creative thinking skills, test result and interview result, it can be considered that the student fulfilled the flexibility aspect in solving the problem.

In Figures 1 show that from the results of students answers, students can mention 5 ideas of the function from A to B with the rule added by 1, the function from A to B with rules multiplied by 2, the function from A to B with rules multiplied by 6 then divided by 3, Function from A to B with rules added by 3, functions from A to B with rules added by 2. Students were able to make a function from A to B with rules multiplied by 6 then divided by 3, this is a novelty, because it has never been taught in class. So students were able to solve problems in a different way with material that already discussed in class in addition the calculation process is correct. Based on the indicators of creative thinking skills, test result and interview result, it can be considered that the students fulfilled the novelty aspect in solving the problem.

Students with high capacity can solve problems with 5 different ideas (fluency). Students with high capability are also capable of solving problems in two different ways (flexibility). Students with high capability are able to solve problems in a different way with material that already discussed in the class and the process of calculation is correct (novelty). Thus, students with high capability fulfilled all indicators of creative thinking skills. As a result, students with high capability have creative thinking level 4 or very creative.

4. Conclusion
Students with high capability solved problem about relations and functions after problem-based learning, used many solutions and many different methods or ways. They also can solve a problem with different solutions and give correct answers. This means students with high capability fulfilled three indicators of creative thinking skills, namely fluency, flexibility, and novelty. Consequently, students with high capability have creative thinking level 4 or very creative.

5. References
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