Students' creative thinking skill and its influential factors in quadrilateral topic viewed by students' cognitive

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Abstract. The purposes of this study were to describe students’ mathematical creative thinking skill in quadrilateral topic viewed by students’ cognitive and to reveal the factors that influence students’ creative thinking. This study was a descriptive qualitative research. The data were collected by using a written test and an interview. The test was conducted to measure students’ mathematical creative thinking and interview was conducted to determine the factors that influence students’ creative thinking. The test used 4 creative thinking questions that each of them covered one of four indicators of mathematical creative thinking. The research subjects were 7th grade students of Integrated Islamic Junior High School, namely Ibnu Khaldun Lembang. The result shows that the higher students’ cognitive the higher students’ mathematical creative thinking skill. The factors that influence students’ creative thinking are the skill to make mathematical models, the skill to see questions at different points of view, and the skill to understand the topic.

1. Introduction
The skill to think creatively is one of the main aspects for the 21st century that allows us to remain flexible and give us flexibility for the challenges that are part of our complex, fast-changing and modern world [1-5]. Not only being implemented in science, creativity has also played an important role in solving problems in everyday life [6-12]. Creativity is needed for all fields of learning, including in the field of mathematics, especially the ability to think creatively which is a measure of the success of students in learning [13]. In addition, mathematical creative thinking skill also play a key role in advanced mathematics which is a necessity in mathematics education in the era of globalization and can be used in solving problems by issuing new ideas and solutions [14, 15]. Therefore, creative thinking skill need to be developed so that students have creativity to solve mathematical problems.

The ability to think creatively can be defined in many ways. Creativity is considered as a skill that uses a variety of idea-making techniques (such as brainstorming), creates new and useful ideas, formulates, flexes, analyzes and evaluates original ideas to improve and maximize creative efforts [16]. The skill to think creatively is a skill that consists of several indicators, among others: (1) fluent thinking skill, the skill to trigger ideas, solve problems and provide answers to a problem, and provide many examples or statements relating to concepts in certain situations; (2) Flexible thinking skill (flexibility), the skill to generate ideas, provide diverse answers, use a variety of resolution strategies, provide examples relating to concepts and to find alternative
solutions for many different; (3) The skill of thinking originally, the skill to give birth to new expressions, unique, unorthodox thinking of ways to express new, unique or unusual statements; and (4) elaboration skill, the skill to explain in detail, enrich, and develop ideas or products, add or specify in detail the situation so that it becomes more interesting, or answers to certain mathematical situations [17, 18, 19, 20, 21, 22, 23]. Important components in mathematical creativity such as expertise, original thinking, and intrinsic motivation and intellectual abilities of each individual have a direct influence on education [24]. Cognitive skill (IQ), EQ, and creativity have a positive correlation between students' cognitive abilities with creative thinking skill but do not occur significantly [25]. This is in line with a study that states that 2/3 of one's creativity skill is obtained through education, while the remaining 1/3 comes from one's genetics. Contrast with the creative thinking skill, 1/3 of intelligence is obtained from education, the remaining 2/3 comes from one's genetic makeup [26]. The following figure is a model of the relationship between creative potential, education, environment and creativity result.

![Figure 1. Relationships model between creative potential, education, environment, and creative performance](image)

From the description above, it can be concluded that there is a positive relationship between the potential of students 'creative thinking abilities and students' cognitive abilities. Therefore, this article discusses specific descriptions of students' creative thinking abilities at each cognitive level of students.

2. Methods
This research is a descriptive research that aims to assess mathematical creative thinking skill in terms of the level of students cognitive (based on students’ midterm test scores). The research subjects were 7th grade Integrated Islamic Junior High School Ibnu Khaldun Lembang which consisted of 32 students. Techniques for collecting data through test and interview. To measure the variables of creative thinking skill, it used 4 indicators which are fluent thinking skill, flexible thinking skill, original thinking skill, and the skill to specify (elaboration skill). The test used 4 questions that have been validated by using AnatesV4. Each question which measure creative thinking skill represents one of the four indicators of creative thinking skill. Data were analysed by the criteria contained in Table 1.
Table 1. Criteria for Level of Students Creative Thinking Skill

| Score    | Criteria             |
|----------|----------------------|
| 86 – 100 | Very creative        |
| 71 – 85  | Creative             |
| 56 – 70  | Moderate             |
| 41 – 55  | Less creative        |
| < 40     | Very less creative   |

Interview was used to determine the factors that influence students' mathematical creativity skill. Interview involved researchers and one student representative of each student's cognitive abilities so that they can describe students' reasons, causes, or obstacles during completing test questions mathematical creative thinking skill.

3. Result and Discussion
The variable in this study is the skill to think creatively, to measure the variable of creative thinking skill, the researcher used four indicators namely fluency thinking, flexible thinking, original thinking and elaboration skill. The description of the results of the study was based on calculating the score of each question where the minimum score is 0 and the maximum score for each question is 4 and the total score for the creative thinking skill test is 16. After examining the students’ answers, the researcher added the scores that each student obtained and converged into values with ranges (0-100) so that creative thinking skill can be categorized based on the criteria of creative thinking skill in table 1. The results of students test after being analyzed and categorized using the assessment categories are as follows.

Table 2. Creative thinking skill in terms of student cognitive

| Cognitive       | Very good | Good | Moderate | Less | Very less |
|-----------------|-----------|------|----------|------|-----------|
| Creative Thinking | 1         | 3    | 2        | 7    | 4         |
| Number of Students | -         | -    | 7        | 4    | 2         |
|                 | -         | -    | -        | 7    | 2         |
|                 | -         | -    | -        | -    | 4         |

Based on table 2, it can be seen that the higher the cognitive level of students the higher the skill of students to think creatively. The only students with very good cognitive abilities have very good creative thinking skill. Then from 5 students who have good cognitive ability have different creative thinking skills which are 3 people have very good creative thinking skill and 2 people have good creative thinking skill. From the 13 students who have moderate cognitive ability show that there are 2 students with good creative thinking skill, 7 students with moderate creative thinking skill, and 4 students with less creative thinking skill. Furthermore, from 9 students with less cognitive skill showed that 7 students had less creative thinking skill and 2 students who had very less creative thinking skill. Furthermore, students with very less cognitive ability only have less creative thinking skill.

Very creative students are able to meet the fluent thinking indicators, which are able to provide more than 2 variations of answers using a combination of all flat shapes. Students can
also fulfill flexible thinking indicators, which be able to determine 3 types of rectangles and which have the same surface area as a rectangle that has a side length of 16 cm and a width of 12 cm lacking in length. Whereas students with very good creative thinking skill are able to meet the original thinking indicators but cannot fulfill the indicators with full scores which are only able to make 2 variations of answers that have originality values in accordance with the requirements desired by the questions. Furthermore, for elaboration thinking indicators, there are 2 students who are able to fulfill the indicator with a full score which namely being able to determine the area of the shaded area by using two or more ways of solving, and 2 students who only fulfill the indicators using two ways of solving to determine the shaded area. The answers of students who have very good creative thinking skill are presented in Figure 2 below.

Figure 2. Student’ answers of very creative thinking skill criteria

Creative students are able to meet indicators to think fluently, think flexibly, think original and think in detail but do not meet the maximum score. Students are only able to fulfill indicators of fluent thinking, namely making two variations of answers by using a combination of all flat shapes, fulfilling indicators of flexible thinking, namely being able to determine 2 types of rectangles and their sides which have the same surface area as a rectangle that has a side length of
16 cm and width 12 cm lack of length, meet the original thinking indicator, which is able to make 2 variations of answers that have originality values in accordance with the requirements desired by the problem, and thinking indicators detailing are able to use two ways of solving to determine the area of shaded areas.

Students with moderate creative thinking skill are only able to meet indicators of thinking fluently, thinking flexibly, and thinking of detailing even if they do not meet the maximum score. On the original thinking indicators students are not able to provide original answers correctly. Whereas students with less creative criteria are only able to meet the indicators of thinking fluently and thinking of detailing even if they do not meet the maximum score, and students with creative thinking skill who are very less unable to meet all indicators of creative thinking well.

Factors that influence students 'creative thinking abilities resulting from interview activities with 5 students representing each criterion of students' creative thinking abilities are (1) the skill to make mathematical models; (2) the skill to see questions in various perspectives, and (3) the skill to understand the topic.

Students’ ability to make mathematical models is seen in question number 2, namely questions with flexible thinking indicators where students are asked to make mathematical models of statements ‘a quadrilateral has a side length of 16 cm and a width of 12 cm lacking in length. Not able to make the mathematical model results inability to determine the surface area of a rectangle so that it cannot make another rectangular shape that has the same area as the rectangle.

Students’ ability to see questions from different perspectives can be seen in questions with elaboration indicators. Students with very less creative thinking skill stated that the students are not able to see questions with a variety of different perspectives so that the elaboration indicators in this study cannot be fulfilled. In questions with elaboration indicators, students are required to determine the area of the shaded area but using different methods. However, students with very less skill to think creatively say that they cannot find a different method.

Students’ ability to understand the material can be seen in interviewing researchers with students on indicators that are flexible thinking and original thinking. In this study students are required to understand the concept of area of a quadrilateral so that they can solve the questions being tested. At the interview, students stated that they did not know the quadrilateral area formula so they could not meet the indicators of creative thinking.

4. Conclusion
Students' creative thinking skill has a positive correlation with students' cognitive. It means the higher level of students' cognitive, the higher level of students' creative thinking skill. Both students of very creative and creative criteria in creative thinking skills are able to meet indicators of thinking fluently, flexibly, original, and elaboration, students with moderate creative thinking skill criteria are only able to meet indicators thinking fluently, flexibly, and elaboration, students with less creative thinking skill are only able to meet indicators thinking fluently and detailing, while students with very less creative thinking skill are not being able to meet the indicators of creative thinking skill. Then factor that influence students 'creative thinking skill are (1) the skill to make mathematical models; (2) the skill to see questions in various perspectives, and (3) the skill to understand the topic.

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