

# The Identification of Students' Mathematical Creative Thinking Ability on Transformation Geometry

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**Abstract** – This research identifies the students mathematical creative thinking ability on Transformation Geometry. This research is a descriptive study carried out on fourth semester. Mathematics Education students of STKIP Sebelas April Sumedang. From the results of data analysis, it is concluded that mathematical creative thinkingability on the subject of Transformation Geometru is still yet reached as expected. Of all 31 students who were given the problem of mathematical creative thinking ability, the result shows that none of mathematical creative thinking ability. Of 31 students, only 5 students or 16% met 3 indicators of mathematical creative thinking, 9 students of 29 % students met two indicators, 11 students or 36% students only met two indicator, and 6 students or 19% did not meet one indicator. So it is necessary to develope learning models that can improve mathematical creative thinking.

**Keywords:** *creative thinking, learning model, mathematical*

In the standard contents of elementary and secondary education units in mathematics according to the Ministry of National Education (2006) it is stated that mathematics subjects need to be provided to all students starting from elementary school to equip students with logical, systematic, critical and creative thinking ability and the ability to work together. This is also in accordance with the 2013 curriculum which also aims to prepare Indonesian people to have the ability to live as individuals and citizens who are faithful, productive, creative, innovative, and affective and able to contribute to the life of society, nation, state, and world civilization. The statement is a necessity so that the ability to think logically, systematically, critically, and creatively as well as the ability to work together become a focus in mathematics education. According to La Moma (2015) Creative thinking in mathematics can be seen as an orientation or disposition about mathematical instructions, including the task of discovery and problem solving. These activities can lead students to develop more creative approaches in mathematics. Thus, it is clear the ability to think creatively is important and must be mastered by everyone, especially in learning mathematics.

Siswono (2011) stated that creative thinking is a process that is used when one brings in/comes up with a new idea. It combines ideas that have not been done before. In general, creative thinking is triggered by challenging problems. The ability to think creatively in problem solving standards by NCTM (2000) includes implementing and adjusting various strategies in solving problems. Potur & Barkul (2009) defined creative thinking as an original cognitive ability and a problem-solving process that allows individuals to use their intelligence in unique ways and directed towards an outcome. The aspects of mathematical creative thinking ability according to Munandar (2009) are fluency, flexibility, authenticity, and elaboration.

## I. INTRODUCTION

Learning mathematics requires everyone to have the ability to understand formulas, to count, to analyze, to group objects, to make props, to make mathematical models, and so on. These activities do not only require ordinary thinking (convergent) activities, but they also require high thinking (divergent) abilities. People with divergent type of thinking are able to generate or create new ideas and are often associated with creative thinking. Divergent thinking is seen as a mental operation that requires the use of creative thinking abilities, including fluency, flexibility, originality and elaboration (Munandar, 2009).

Creative thinking in mathematics refers to the notion of creative thinking in general. Creative thinking in mathematics emphasizes three aspects; they are fluency, novelty, and flexibility (Silver, 1997; Siswono, 2007). Munandar (1999) indicated that the ability to think creatively is the ability to find many possible answers to a problem, where the emphasis is on the quantity, accuracy, and diversity of answers. Furthermore, Munandar (1999) explained that the characteristics of the ability to think creatively is fluency (fluent thinking skills) that is thinking fluently have the characteristics of triggering a lot of opinions, answers, problem solving, providing many ways or suggestions in doing various things, and always think of more than one answer; flexibility (i.e. flexible thinking skills) that is the ability to generate ideas, answers, or questions that vary, can see a problem from different points of view, look for many different alternative solutions and be able to change the approach; originality, it is the ability to create new and unique ideas, think of unusual ways to express themselves, and be able to make unusual combinations; elaboration (detailing skills) is the ability to enrich and develop an idea or product, and add or thoroughly explain in detail of a situation to make it more interesting.

Through these aspects creative thinking can be measured its achievement by identifying through open questions. Fluency is related to the ability to easily arouse a large number of ideas. Flexibility refers to the ability to generate many ideas. Novelty is the basis of authenticity, purity, and discovery. Originality is the ability to generate extraordinary ideas, solve problems in extraordinary ways, or use things or situations in extraordinary ways. Elaboration is the ability of a person to send details to complement existing relationships or grounded framework (Evans, 1994).

Therefore mathematical creative thinking ability can be measured based on the level of fluency, flexibility, originality, and elaboration. This will become aspects of measurement in measuring mathematical creative thinking ability. The following table represents creative thinking behavior and its meaning according to the aspects measured (Munandar, 2009; Evans, 1994).

Table 1. creative thinking behavior and its meaning according to the aspects measured

<b>Indicators of creative thinking</b>	<b>The Description of Indicators of Creative Thinking</b>
Fluency	- Generate many relevant ideas/ answers - Smooth flow of thought.
Flexibility	- Generate variety of ideas - Able to change the way or approach - Different directions of thinking
Originality	Give unusual answers, different from others, which are rarely given by most people.
Elaboration	- Develop, add, and enrich ideas. - Work in details.

Based on some opinions of experts about creative thinking, it can be drawn some general characteristics of creative thinking, namely as follows:

1. The ability to think fluently (fluency) is the ability to generate many ideas or ideas that are relevant in solving a problem.
2. The ability to think flexibly (Flexibility) is the ability to propose various ways or approaches in solving the same problem.
3. The ability to think original (Originality) is the ability to generate ideas that are uncommon as a result of his own thinking in solving a problem.
4. The ability to think in detail (Elaboration) is the ability to develop, add, enrich ideas or detail a problem to be simpler.

From the description above, it is clear that the ability to think creatively is important so it must be mastered by elementary school students up to university students, especially in learning mathematics. The importance of mathematical creative thinking ability is not directly in accordance with the conditions in the field. Students' mathematical creative thinking ability is still low. There are previous studies which stated that students' creative thinking ability does not meet expectations, including as has been done by Murtafiah (2017) with several conclusions including: (1) students with high initial abilities do not have fluency and flexibility in thinking, but show novelty in thinking; (2) students with initial ability have fluency in thinking, but do not have the flexibility and novelty of thinking; (3) students with low initial ability do not have fluency, flexibility, and novelty of thinking. These conclusions indicate both students with high

initial abilities, moderate, or low are still lacking in creative thinking ability.

Based on the description above, this study has the aim to identify the mathematical creative thinking ability of Transformation Geometry on fourth semester mathematics education students of STKIP Sebelas April Sumedang. The benefit of this research is it can be used as a material for consideration to develop learning models that can improve students' mathematical creative thinking ability.

II. RESEARCH METHODS

This research is a descriptive study that will identify mathematical creative thinking ability skills on fourth semester mathematics education students of STKIP Sebelas April Sumedang, involving 31 students. Descriptive research describes variable, symptom or condition as they are. (Arikunto, 2000).

This research begins by compiling mathematical creative thinking ability test questions on the Transformation Geometry subject which is Isometric. Furthermore, the test questions were tested on fourth semester mathematics education students of STKIP Sebelas April Sumedang who had studied the material. Then the results of answers from students were analyzed and adjusted with indicators of mathematical creative thinking ability.

The instrument in this study was the researchers guided by the task sheet instrument in the form of a test of mathematical creative thinking ability. Researchers are part of instruments because researchers act as planners, data collectors, data analyzers, data interpreters, and become reporters of research results. In addition, researchers were also guided by interview guide sheets.

III. RESULT

Based on the results of an analysis of 31 students who were given a mathematical creative thinking ability test, the result showed that none of them has fulfilled all (four) indicators of mathematical creative thinking ability. Of 31 students, only 5 students or 16% met 3 indicators of mathematical creative thinking ability, 9 students or 29% of students met two indicators of mathematical creative thinking ability, 11 students or 36% of students only met one indicator, and 6 students or 19% did not meet any indicators. Here is a test of mathematical creative thinking ability that was given to students.

Problem: Given a line  $g$  and transformation  $T$  defined as follows.

i) .

ii) is the midpoint of the line segment from  $t$  to which is perpendicular if .

Is this transformation  $T$  isometric?

One of the students' answers that is marked as "Good" in working on the transformation geometry can be seen in the picture below.

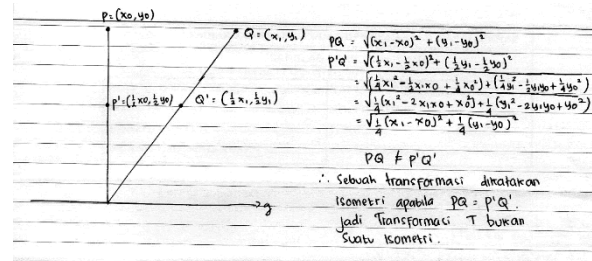


Figure 1. Instance of Students' Answers

From the picture above it appears that not all indicators of creative thinking can be fulfilled. The description of each indicator of mathematical creative thinking ability is related to the problem above as follows.

1. Fluency in Creating Images

Fluency in creating images is not correct or not in accordance with the problem, which in the picture does not reflect the length of  $PQ$  and the length of  $P'Q'$  as an isometric requirement,  $PA = P'A$ . One of the correct alternative answers is the picture as follows.

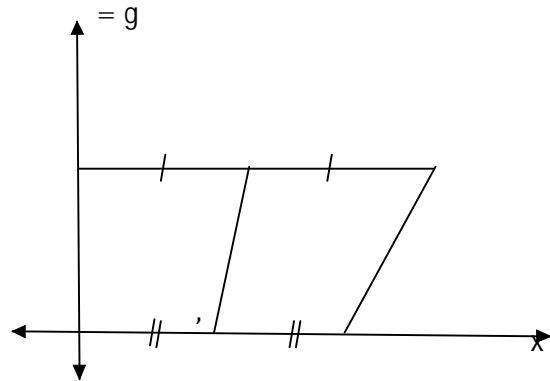


Figure 2 the correct alternative answers

2. Flexibility in creating sketch identity

Flexibility in creating sketch identity is not correct. One of the correct alternative answers is shown in Picture 2 above.

3. Originality in combining several ideas

The idea to combine the length formula is correct, but because the picture and the idea to solve the problem are wrong, the final result is still wrong. The alternative answers to Figure 2 above are as follows.

Look at Figure 2 above.

Consider:  $x$ ,  $y$  axis as  $x$ , and ordinate as  $y$ .  
and hence  $T$  and  $T^{-1}$  =  $(x, y)$

with the formula of the length:

$$= \sqrt{x^2 + y^2} \quad \text{and}$$

$$=$$

$$=$$

Since so  $T$  is not isometric

#### 4. Details in making conclusions

The detail in making a conclusion is right to fulfill the concept of isometric, but because the initial idea is wrong so the conclusion is invalid. The student's answer above is one sample of students' answers that are considered to have "Good" mathematics ability. But the ability to think creatively still does not meet the expectations, so it still needs to be improved.

Based on the facts as described above that the ability of students to think creatively is not as expected, even though mathematical creative thinking ability is very necessary in learning mathematics, for they can find solutions to existing problems through creative ways. Like Thomas Alfa Edison with his hard work and creativity, he was able to make a light bulb. However, it is not easy to develop one's mathematical creative thinking ability.

#### IV. CONCLUSIONS

From the results and discussion above it can be concluded that mathematical creative thinking ability on the fourth semester mathematics education students of STKIP Sebelas April Sumedang is still not as expected. Of 31 students who were given the problem of mathematical creative thinking ability, the results show there is no student who completely fulfilled all or 4 indicators of creative thinking.

Of all 31 students, only 5 students or 16% who met 3 indicators of mathematical creative thinking ability, 9 students or 29% of students who met two indicators of mathematical creative thinking ability, 11 students or 36% of students only met one indicator, and 6 students or 19% did not meet any indicators.

From the discussion and conclusions above, it can be seen that the mathematical creative thinking ability of students on Transformation Geometry especially the isometric problem is still not as expected. So it is necessary to develop learning models that can improve students' mathematical creative thinking ability.

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