An analysis of junior high school students’ creative thinking skills in solving flat-side geometry problems

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Abstract. The study was aimed at analysing the students’ creative thinking skills at SMP Negeri 2 Bandung, focusing on the fluency, flexibility, originality, and elaboration aspects in solving the flat-side geometry problems. This type of research is qualitative. Tests, interviews, and documentation were utilized as the data collection methods. The students of class VIII-D were chosen as the subject, six of whom were taken as the sample, consisting of two students with high mathematical skills, two moderate, and two low. The findings reveal that the students with high mathematical skills experience no obstacle in the fluency and flexibility aspects, while in the originality aspect the inability to provide creative answers is still exhibited by some students, and in the elaboration aspect the students represent lack of accuracy and detail in answering the elaborative questions. The moderate mathematical-skilled students still indicate difficulty in understanding the problems given, whereas the low mathematical-skilled students show difficulty in understanding the problems. Therefore, they can merely provide less-structured, unsystematic, undetailed answers, and they do not solve many problems as well. This is due to considerable obstacles they still experience.

1. Introduction

Creativity is a feature or characteristic of a person’s personality that will be used in everyday life. Creativity can also help students to be flexible when dealing with everyday life situations [1]. Mathematical creativity is defined as one of the challenging tasks for school teachers [2]. So, in mathematics learning teachers must prepare students to be able to deal effectively with the situations of daily life that are produced through creative thought processes.

Creativity is one of the results of creative thinking. Creative thinking refers to an important thinking skill for students of various levels of education. Creative thinking skill is an ability to produce new ideas or thought in order to generate a way or more to solve problems, and even produce new ways as alternative solutions [3]. Furthermore, Ervynck defines mathematical creative thinking as a person’s ability to solve problems by developing his thinking which refers to the logical, didactic nature of knowledge and relates the content that exists in mathematics [4]. Therefore, it is crucial to implement the management of creative thinking skills in every school subject, especially mathematics.

Mathematics is one of the subjects learned at every level of education, which is expected to train students to learn to think in a practical, critical, creative and systematic ways in take some actions [5]. Creative thinking in mathematics constitutes a combination of logical thinking and divergent thinking.
which is based on intuition yet in consciousness considering flexibility, fluency and novelty. Thus, creative thinking in mathematics can be seen as an orientation or disposition regarding mathematical instruction, including discovery tasks and problem solving tasks [6]. Silver stated that creative thinking can be developed with open questions. Meissner also stressed the idea that creative thinking can be developed through challenging questions [7].

The aspect of creative thinking should be an important aspect in learning mathematics. However, the reality in the field of creative thinking ability is still very rarely developed in the learning process. The low ability of students’ creative mathematical thinking is caused by several factors, including lack of student activity and participation in the process of learning activities. Many students do not pay attention to the teacher’s explanation when explaining the lesson. And many students also lack training in non-routine math assignments. Therefore, it results in low students’ creative thinking abilities and students’ active role in learning activities. This is what makes students’ creative thinking skills remain low. Creative thinking is the realization of high order thinking. According to the PISA over the years, the results obtained has still not been satisfactory. The findings in the recent year, 2015, indicating a score of 386 in the mathematical competence has increased if compared to the 2012’s results with a score of 375 [8]. Nevertheless, if compared to the overall average of 490, the performance level still remains below the average [9].

Moreover, the results of the TIMSS study in 2015 reveal that Indonesian students need to strengthen their skills in integrating information, drawing conclusions, and generalizing knowledge they have owned into other matters [10]. The Indonesian students still need to develop themselves with regard to the high-level mathematical skills. One of the ways of high-level thinking is to be able to think creatively.

This is relevant to the study conducted by Indrie Noor Aini which concludes that the students’ level of creativity is still low, i.e. at 0.45. The results indicate that the students’ creative thinking skills are still low. In the learning process, each student has a different way of achieving learning goals [11], one of which is that they need to think creatively when faced with information or data conflicting from a variety of sources and contexts. Based on Munandar, the indicators of creative thinking are presented in details as follows [12].

1. Fluency, which includes:
   a) To produce a lot of ideas, answers, problem-solving, and questions fluently.
   b) To think of more than one answer.
2. Flexibility, which includes:
   a) To produce various ideas, answers or questions.
   b) To search for many different alternatives or directions.
3. Originality, which includes:
   a) To generate new and unique expressions.
   b) To think of unusual ways.
   c) To make unusual combinations of parts.
4. Elaboration, which includes:
   a) to enrich and develop ideas or products.
   b) to add or elaborate details of an object, idea or situation which make it more interesting.

In line with the statement, Balka suggests that mathematical creative thinking skills include both convergent and divergent thinking abilities. Based on those ideas, the researcher of the present study set a number of indicators as the measure as follows: fluency, flexibility, originality and elaboration [9] in order to have the students’ knowledge develop.

2. Methods
This research is a qualitative study. Research location refers to the place used to carry on this study in order to obtain the desired data. The study took place at the Public Islamic Junior High School (MTs Negeri) 2 Bandung May 10th, 2019, particularly during the Mathematics lesson. The study was conducted in class VIII-D of MTs Negeri 2 Bandung. The purpose of the study is to explore the students’
creative thinking skills regarding the flat-side geometry subject matter at the level of Grade VII of junior high school (SMP/MTs). This is a qualitative study. A qualitative research refers to one of the research procedures which produces descriptive data in forms of speech or words and behavior of certain people observed [13].

According to this, it can be stated that the qualitative research methods were carried out carefully, and the researchers participated in the field, recorder, interviewed in detail, analysed various data found in the field, and write the detailed research report. Instrument is defined as a tool utilized to collect data needed in a study. The instrument used in the study was a test in the form of a description (essay) containing 4 questions in total, continued with unstructured interviews in order to support the description of the process of creative thinking in details. The data analysis was carried out during and after the data collection, the qualitative method was performed to analysis the students’ creative thinking process in completing and resolving the problems of flat-side geometry.

3. Result and Discussion
The present study was conducted at SMP 2 Negeri Bandung with a total of 31 students of class VIII-D as the subject. Based on the student report cards and mathematics teacher’s considerations, six students were selected as the research sample, consisting of two students with high mathematical skills, two moderate, and two low. In order to measure the students’ creative thinking skills in solving problems, indicators of creative thinking skills were used, i.e. fluency, flexibility, originality and elaboration. The results of this study were obtained from the results of the writing test of creative thinking skills.

To figure out the students’ creative thinking skills in solving the flat-side geometry problems, a test of creative thinking skills was prepared and administered by the researchers, consisting of 4 questions/problems. The analysis results of the test of creative thinking skills in solving problems for 31 students as the subjects of the study can be presented in table 1.

Table 1. Recapitulation of the Students’ creative thinking skills in solving problems

| No | Fluency | Flexibility | Originality | Elaboration | Number of Student |
|----|---------|-------------|-------------|-------------|------------------|
| 1  | √       | √           | √           | √           | 2                |
| 2  | √       | √           | -           | -           | 3                |
| 3  | -       | √           | √           | -           | 8                |
| 4  | √       | -           | √           | -           | 1                |
| 5  | -       | √           | -           | -           | 5                |
| 6  | -       | -           | √           | -           | 2                |
| 7  | -       | -           | -           | -           | 10               |

According to Table 1, it can be seen that there are 2 students who are capable of four indicators of creative thinking, which means that students have fulfilled fluency, flexibility, original indicators and elaboration. There are 3 students who meet the fluency, flexibility and original indicators. Then, 1 student meets the flexibility and original indicators. 5 students meet the fluency and originality indicators. 2 students meet the originality indicator. At last, 10 remaining students have not demonstrated ability to meet each of the fluency, flexibility, original, and elaboration indicators.

After providing the test of creative thinking skills in solving problems, then the interviews were conducted in order to find out in detail the student creative thinking skills in solving the flat-side geometry problems. Interviews were conducted to a number of 6 subjects consisting as follows: two students with high mathematical skills named BC and ADH, two with moderate skills named AA and SHT, and two with low skills named FRP and NW.

Based on the results of interviews with BC, for the fluency indicator it was known that BC is able to solve the problem well and to create two different chocolate-shaped bars and solve them, for the flexibility indicators BC is able to solve the problem and to provide alternative solutions, for the...
originality indicator BC can solve the problem which is by developing a flat-side geometry question/problem, and for the elaboration indicator BC can solve the problem correctly and accurately. Overall, BC is able to answer the questions and use the problem-solving steps correctly, and is also confident that the answers given are correct.

The results of interviews with ADH reveal that for the fluency indicator it was obtained that ADH is able to solve the problem well and to create three different chocolate-shaped bars and solve them, for the flexibility indicators ADH is able to solve the problem and to provide solutions, for the originality indicator ADH can solve the problem which is by developing a flat-side geometry question/problem yet it is still very simple, and for the elaboration indicator ADH can solve the problem in details. For the questions which can be answered, ADH do it by using problem-solving steps and ADH is certain that the answers given are correct.

The results of interviews with AA show that for the fluency indicator it was obtained that AA has not been able to solve the problem, for the flexibility indicators AA is able to solve the problem correctly yet lack the appropriate problem-solving steps, for the originality indicator AA can solve the problem which is by developing a flat-side geometry question/problem yet it is still very simple and represents no creative thinking, and for the elaboration indicator AA has not been able to solve the problem because has no idea of how to execute it. For the questions which can be answered, AA can answer the flexibility- and originality-related questions correctly by the problem-solving processes having met the correct steps, and is certain that the answers given are correct.

The results of interviews with SHT represent that for the fluency indicator SHT is able to solve the problem well and to create two different chocolate-shaped bars and solve them, for the flexibility indicators SHT is able to solve the problem and to provide alternative solutions, for the originality indicator BC can solve the problem which is by developing a flat-side geometry question/problem, yet it is still very simple, and for the elaboration indicator SHT has not been able to solve the problem correctly. For the questions which can be answered, SHT can answer the fluency, flexibility and originality-related questions correctly. However, in problem solving process has not entirely fulfilled the correct steps, which is that SHT did not provide the known and asked features within the question provided.

The results of interviews with FRP show that for the fluency indicator FRP has not been able to solve because of confusion during the work, for the flexibility indicators FRP has not been able to solve the problem, for the originality indicator FRP has not been able to solve the problem due to inability to remember the type of flat-side geometry question, and for the elaboration indicator FRP has not been able to solve the problem as honestly stating the inability to solve the problem given.

The results of interviews with NW indicate that for the fluency indicator NW has not been able to solve due to hesitation of what was actually asked and of the way of solving it, for the flexibility indicators NW has not been able to solve the problem, for the originality indicator NW has tried to answer the question but still has not met the indicator, and for the elaboration indicator NW has not been able to solve the problem as not knowing how to solve the problem provided in the question.

The interviews were conducted in order to strengthen the students’ answers and to find out their creative thinking skills in solving the flat-side geometry problems. Therefore, some information was obtained as follows: 1) some students are found to be confused in solving the fluency-related problems, 2) some students are not able to solve the flexibility-related problems, 3) some students are found to be trying to solve the originality-related problems, 4) most of the students are not able be answer the problem by using the proper way of problem-solving steps, 5) some students are found to be confident of their answers.

The assessment used by the researchers in order to figure out the creative thinking skills of the class VIII-D students of SMP Negeri 2 Bandung was in accordance with the creative thinking criteria described by Munandar which outline the creative thinking indicators in detail as follows. Fluency includes: Generating numerous ideas, answers, problem-solving, and questions fluently; Providing many ways or suggestions for doing various things; Thinking of more than one answer. Flexibility includes: producing various ideas, answers or questions; see a problem from a different perspective;
looking for many different alternatives or directions; changing the approach or way of thinking. Originality includes: producing new and unique expressions; thinking of unusual ways; making unusual combinations of parts [9]. Elaboration includes: enriching and developing an idea or product; add some details to an object, idea or situation to turn it to be more interesting.

From the analysis, several points are found by the researchers as follows: 1) some differences appear in the students’ creative thinking skills; 2) most of the students can solve the problems by the fluency indicator since they are able to produce a variety of answers and ideas; 3) the students with high mathematical skills have such high creative thinking skills; 4) some students having moderate mathematical skills have moderate creative thinking skills; 5) the majority of students are less careful in examining the questions/problems given.

The analysis results show that two high-skilled students can achieve the high level of creative thinking, meaning that they meet the four indicators of creative thinking. They are able to understand the problems as well as to predict the solutions, then develop a plan, implement the plan and look back if obstacles in obtaining the solution appear. They can communicate their ideas clearly both verbally and written. They are also skilled in combining ideas of their own. This is relevant to Puspitasari, In’an and Syaifuddin statement which is that an individual’s creative thinking skills tend to be higher when he/she is able to present many possible answers to one problem [14]. This type of person is able to process knowledge better than others, able to combine ideas which originates from the previously learned knowledge. Therefore, when viewed from the level of creativity, the higher the students’ levels of creativity, the more complex their ability in uniting ideas.

Also, the study finds the students with the moderate ability towards the whole indicator, that is fulfilling the fluency, flexibility and originality indicators. For the problems which examine the originality indicator, the high-skilled students are able to solve them well but in the usually way as taught by the teacher. The moderate-skilled students are able to understand the problems and predict solutions, develop plans and implement them, but once faced to the obstacles while carrying out their plans, they give up easily.

The low-skilled students are considered at a low level of creative thinking (not creative) as well because they are unable to exhibit the four indicators of creative thinking as mentioned before: fluency, flexibility, originality and elaboration. They have difficulties in understanding the problems and estimating the solutions. When developing a plan, they are not sure whether the method they choose is correct or not. This leads to the completion not being well structured, not systematic, not detailed, and as a result, many problems cannot be solved. This happens because these type of students still experience a lot of obstacles.

All of the findings presented above show that the level of creative thinking of each student varies. This is in accordance with Guilford’s statement that in terms of creative thinking two assumptions are built, i.e: firstly, everyone can be creative to a certain degree in a certain way. Secondly, creative thinking skills are the skills that can be learned. So, each individuals possess distinct degree of creativity and has their own way to realize their creativity. Also, Amiable describes that one can have the ability (higher or lower degree) to produce new works in their fields, so that they are said to be more or less creative [15].

4. Conclusion
Based on the data analysis and findings, the researcher’s states that the students’ creative thinking skills in the present study were examined by how the students solve the problems provided. The results of interviews and written answers with the students of class VIII-D who are divided into high, medium and low mathematical skills based on report cards, can be concluded as follows: 1) The high-skilled students are able to achieve a high level of creative thinking, meaning that they meet the four creative thinking indicators. 2) The moderate-skilled students can achieve the fluency, flexibility and originality indicators. For the originality-related problems, the high-skilled students are able to solve them well but in the usually way as taught by the teacher. 3) The low-skilled students are at the low level of creative thinking (not creative) as well since they are unable to exhibit the four creative thinking indicators
namely fluency, flexibility, originality and elaboration. They have difficulties in understanding the problems and estimating the solutions.

5. References

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