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⁶Junior high school students' mathematical creative thinking ability based on gender differences in plane and solid geometry subjects

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⁴**Abstract.** Mathematical creative thinking is the ability of students to find solving ways that are unusual, unique, and have never been found by others. The development of the concept of mathematical creative thinking can make students despair and give up, so that another ability is needed so that they are able to survive and turn their difficulties to be opportunities for themselves to advance. This study aims to determine the mathematical creative thinking ability of class VIII junior high school students in one of the junior high schools in Bandung Barat on the subject to construct plane and solid geometry based on gender differences. ¹⁴ samples are 4 students consisting of two men and two women. Besides that, the discussion of mathematical creative thinking skills for junior high school students is viewed from gender differences, between male and female ¹² students in terms of their creative thinking ¹³ abilities. The instrument of this research is a test of the ability to think creatively and interview. This study is a descriptive qualitative research that aims to describe the ability of creative thinking mathematically in solving problems of plane and solid geometry. The results show that the ability difference between male and female students is that the female students have much better mathematical creative thinking. In addition to gender factors, other factors can also influence the achievement of creative thinking skills; namely, students and teachers' readiness to learn, students' basic abilities and knowledge of mathematical concepts. Male students are more detailed in explaining the shape of each space given to the problem.

1. Introduction

One of the subjects that is compulsory at school is mathematics. Mathematics plays an important role in the advancement of science and technology today. This is in accordance with its nature, namely the mathematics of science ministers and ¹³ been of sciences for other disciplines. In addition, mathematics is able to train high-level logic and creative thinking processes. One of the important materials in mathematics learning is plane and solid geometry. Because of its importance, geometric material is given to students ranging from elementary school level to upper secondary level. But in reality, even though geometry material has been known to students since in elementary school, junior high school students often experience difficulties when facing this material, especially in solving problems in plane and solid geometry [1–4].

The three indicators used to assess creative thinking skills are fluency, flexibility and novelty [2–4]. Fluency is when students are able to solve mathematical problems with several alternative answers (diverse) and correct; flexibility (flexibility) is when they are able to solve mathematical problems in different ways; novelty is when they students are able to solve mathematical problems with several



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different answers but are true and one answer that is not normally done by students at the stage of their development or level of knowledge. Gender differences are often cited as one of the factors that influence a person's development, both in terms of physical development and in terms of cognitive development. Likewise, a person's thinking ability can be influenced by gender factors. [5] states that gender influences learning achievement, because gender is a sociocultural and psychological dimension of men and women. [6] state that gender is different from sex. Sex categorizes a person as male and female based on biological characteristics, while gender refers more to its social characteristics. Gender is a characteristic that arises due to the influence of social, cultural, social status and roles in society. This is in line with the statement that gender is nature and behavior inherent in men and women that are formed socially and culturally [7]. In this case the definition of gender differences is sex differences, namely men and women. Women have the ability to be more accurate and detailed in solving problems than men.

2. Method

The method of this research is deskriptive qualitative by using a test instrument about spatial ability and questionnaire. The researcher analyzed the mathematical value of the student report card to determine the subject of the study. The selected topics are based on the highest score and gender so that the expected level of students' geometry thinking can be identified. There were 10 students and 10 female students in class VIII of SMP 2 Ngamprah Middle School 2018/2019 Academic Year. The samples are given tests and questionnaires. Sex is also carried out on each other based on male and female abilities.

3. Result and Discussion

Research activities are to retrieve data about the analysis of mathematical creative thinking abilities of junior high school students in solving geometric problems in terms of Gender differences carried out in class VIII of SMP Negeri 2 Ngamprah in the academic year 2018-2019. In this study the data analyzed is the answer to the results of tests of mathematical creative thinking skills and interviews related to the answers given to the test questions of creative thinking ability. The subjects used in this study were given L labels for male students and ¹⁴ for female students. The following picture shows the results of students completing the problem of the ability to think creatively on the concept of solid geometry.

$$\begin{aligned}
 V_{\text{Layang}} &= 15 \times 20 \times 10 = 3000 \text{ cm}^3 \\
 V_{\text{Segitiga keju}} &= 6 \times 15 = 900 \text{ cm}^3 \\
 \text{adonan} + \text{keju} &= 2500 + 900 = 3400 \text{ cm}^3 \\
 \text{isa adonan} &= \frac{3400}{4} \\
 &= 850 \text{ cm}^3
 \end{aligned}$$

Figure 1. L1 Work Result on Fluency Indicator

$$\begin{aligned}
 &\text{Dik: } r = 10 \text{ cm} \\
 &\text{Dit: } V_{\text{adonan}} \\
 &\text{Jwb: } V_{\text{adonan}} = V_{\text{cilindris}} + V_{\text{keju}} \\
 &V_{\text{cilindris}} = \pi r^2 t = 3.14 \times 10^2 \times 10 = 3140 \text{ cm}^3 \\
 &V_{\text{keju}} = \frac{1}{3} \pi r^2 t = \frac{1}{3} \times 3.14 \times 10^2 \times 6 = 628 \text{ cm}^3 \\
 &\text{adonan keju} = 3140 + 628 = 3768 \text{ cm}^3 \\
 &\text{isa adonan} = \frac{3768}{4} = 942 \text{ cm}^3
 \end{aligned}$$

Figure 2. L2 Work Result on Fluency Indicator

Based on Figure 1 it is known that L1 in solving problems is incomplete in interpreting the problem. L1 does not use the word "enough" to indicate the adequacy of the cookie dough. However, L1 is correct in writing the unit volume symbol. L2 students are not right in writing the unit volume symbol. This shows that L2 is less complete in interpreting the symbol of chemistry. L2 also incorrectly wrote the unit "3000 pan should be 3000 cm³". But L2 is able to complete calculations well and understand what is being questioned in the question. L2 gives a unit symbol incorrectly. L1 and L2 students still have not been able to work on the problem in various alternative ways of answer. They are only able to solve questions in one way. They do not have the ability to think fluency creative thinking. For the results of the work of L1 and L2 students the question of the ability to think creatively that has an indication of flexibility is shown in Figure 3.

$V_{\text{balok}} = 15 \times 10 \times 10 = 1500 \text{ cm}^3$
 $V_{\text{tabung}} = 150 \text{ cm}^2 \times 6 = 900 \text{ cm}^3$
 $Najla \text{ mempunyai } 2500 \text{ cm}^3 \text{ adonan kue}$
 $2500 \text{ cm}^3 \text{ adonan kue}$
 $900 \text{ cm}^3 \text{ kue}$
 3400 cm^3
 $3000 \text{ cm}^3 - 3400 \text{ cm}^3 = 400 \text{ cm}^3$
 dapat membuat pesanan setiap adonannya lebih 400 cm³

Figure 3. P1 Work Result on Fluency Indicator

$V_{\text{balok}} = 15 \text{ cm} \times 10 \text{ cm} \times 10 \text{ cm} = 3000 \text{ cm}^3$
 $V_{\text{kue}} = 150 \Rightarrow 150 \times 6 = 900$
 $= 2500$
 $3400 - 3000 = 400$
 $\frac{900}{3400} \rightarrow \text{jadi, cukup, kelebihan } 400$

Figure 4. P2 Work Result on Fluency Indicator

S1 and S2 students understand and are able to solve the problem almost right and right. Algebraic calculations are correct. S1 students are correct in writing volume units while S2 students are still not precise in writing volume units. S1 students and S2 students have not been able to solve questions in different and unique ways. They also have not been able to solve the problem of various alternative correct answers. They are able to answer questions in a way that is what the teacher says in the class. S1 and S2 students tend to solve only one answer. The answers of students were able to provide good explanations and solve questions in a structured manner.[8] that students who have problem solving skills in accordance with the stages of understanding problems, planning problems, and solving problems means that students already understand math problems. Students with lower abilities have never solved the problem of creative thinking skills previously worked on. According to [9] that students' mistakes in solving mathematical problems are conceptual errors, among them students do not understand the meaning of the questions given. [10] Male students are more detailed in explaining the shape of each space given to the problem. The male student's perspective is broader. But in writing female students' answers more neat, so that the reader is easier to read the responses

a) lebar = ... ?
 $15 \times 11 = 180$
 $6 \times 11 = 72$
 $\text{jumlah} = 180 + 72 = 252$
 $360 - 252 = 108$
 $108 \div 3 = 36$
 b) panjang kawat = $4(15 \times 6) = 120 \times 3 = 360$
 c) $15 : 6 : 5 : 2$

Figure 5. L1 Work Result on Flexibility Indicator

a) p. kawat = $4p + 4l + 4t$
 (banyak kawat di tali 3 kawat, ada 2 kawat)
 $360 = 12 \cdot 15 + 12 \cdot 6 + 12 \cdot 6$
 $360 = 180 + 12 \cdot 6 + 72$
 $360 - 252 = 108$
 $108 \div 12 = 9$
 b) tidak ada
 c) $15 : 6$
 $\frac{15}{3} : \frac{6}{3} = 5 : 2$

Figure 6. L2 Work Result on Flexibility Indicator

L1 and L2 students have been able to solve the problem of creative thinking skills with flexibility indicators correctly and correctly. L1 students provide solutions to the problem in a different way. It is just that L1 and L2 students still have not carefully written the volume unit. [11] suggest that students' ability to work on problems and solutions to the problems they face depends on understanding the concepts of the material being studied. This supports students working and solving problems to the fullest and being able to answer what they want. [12] State that the steps to work on students according to the examples given by the teacher make the students do not understand what is being studied before they just follow the procedures that have been taught without digging deeper and even tend to let their understanding there is no opportunity to ask questions or discuss. Seen in Figure 5 the results of the answers of male students are very clear and structured starting from understanding the questions by writing down known elements to finding answers according to mathematical and physical concepts. But gender differences are not the main factor in achieving mathematical creative thinking skills, many factors must be considered in learning mathematics, among others, is the willingness of students to learn mathematics, the atmosphere and methods of learning mathematics, and the most important is readiness in the learning process between students and also teacher.

From the results of the tests of students L1 and L2 in Figure 6, it shows that the questions with novelty indicators are able to provide answers to questions at a higher level of knowledge than cognitive

abilities. Male students are able to solve ¹³ mathematical problems with several different answers but are true and one answer that is unusual for students at their developmental stage or level of knowledge. While students P1 and P2 have not been right to give a problem solving on the indicator novelty. Students P1 and P2 are still low in cognitive abilities for higher-order thinking. Students who have good mathematical abilities will be able to work on math problems from easy levels, while even problems with difficult levels of difficulty. The answer to students P1 and P2 still seems confused when answering, starting from identifying the problem, there is still confusion which results in a misconception when completing the solution. This shows that students' creative mathematical thinking skills will support their abilities in mathematical problem solving. Of course their ability will provide success in learning achievement. The values obtained from cognitive tests and affective values during the learning process take place in the classroom, making it an indicator of learning success.

According to [7] gender differences not only result in differences in abilities in mathematics, but also how to obtain mathematical knowledge. Keitel stated "Gender, social, and very powerfully interacting in conceptualization of mathematics education, ..." Based on Keitel's opinion that gender, social and cultural influences on Mathematics learning. Furthermore, [7] explained that, compared to female students, male students were more interested in math, so female students were more anxious in facing mathematics compared to male students. Therefore gender aspects need to be of particular concern in learning mathematics. In other words, the change in the learning process of mathematics is fun to pay attention to aspects of gender differences so that male and female students are no longer afraid or anxious in mathematics.

There are several internal factors that influence the condition of students, namely internal factors and external factors. Internal factors, namely factors originating from within themselves, where the mental child or inner child is less healthy so that children become less confident, with ⁹ examples they feel unworthy, then the interest in the interest is very influential on student achievement, students who have no interest good learning will have a bad impact on the learning process which results in students becoming easily bored in learning and not caring because they are lazy to learn. External factors that come from outside the individual, the condition of the learning environment that is not conducive, the teacher who behaves rudely when students make mistakes, the learning atmosphere that is made uncomfortable and pleasant. So that the impact of students has anxiety, fear and makes students feel unable to learn and unable to understand the subject matter which will then make students' self-confidence in their own abilities decrease. The experience experienced by these students affects students in understanding and solving problems. Other than that the subject did not understand the concept that involved the problem so that he could not at all work on the problems given. As [13] state that the student's obstacle in solving math problems lies in the basic concept because of the previous misconception so that students find it difficult to understand the next concept.

4. Conclusion

¹² Based on the results of data analysis on the results and discussion, it can be concluded that the mathematical creative thinking abilities of L1 and L2 students are classified as moderate while students P1 and P2 are still relatively low. They are still having difficulty understanding the problems in the question, placing or connecting what is asked and what is known in the problem, especially in the issue of novelty indicators. So it is difficult to solve the problem of the ability to think creatively. Based on the conclusions in this study, it is suggested as follows: (1) In order for students to get used to understanding mathematical problems with indicators of the ability to think creatively, the teacher needs to provide many high-level questions to them; (2) the students must be accustomed to planning and completing high-level problem questions. (3) In order for the students to carry out the solution using the planned strategy, the teacher needs to provide how to use a good strategy in solving problems in the story problems. (4) This research can be continued by examining other mathematical abilities at the elementary and high school levels other mathematical abilities at the elementary and high school levels.

Acknowledgments

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