Misconceptions of seventh grade students in solving geometry problem type national examinations

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Abstract. The general aim of mathematics is stated as making an individual acquire the mathematical knowledge needed in the daily basis, teaching how to solve problems, making him/her have a method of solving problems and acquiring reasoning methods. For this purpose to acquire mathematical concepts one should be able to visualize the mathematics problems. In other words, mathematics is the field in which preconditions are crucial so before the teaching process student backgrounds on the subject should be tested. The principal aim of this study is to find the weaknesses of secondary school students at geometry questions of measures, angles, and shapes in SMP N 2 Pundong. The year 7 curriculum contains 4 geometry topics out of 17 mathematics topics. In addition to this, this study aims to find out the mistakes, 7th-grade students made in solving geometry problem type national examinations. To collect data, students were tested using 10 questions on geometry to analyze their problem-solving skills and to test how much they acquired the last academic year. Frequency distribution table were used in data analysis. A descriptive qualitative methodology and teacher interview were used in the study to analyze and interpret the results. The results from this study revealed that 7th-grade secondary school students have a number of misconceptions, lack of background knowledge, reasoning and basic operation mistakes at the topics mentioned. The misconceptions divide into three categories namely errors in using formula of geometry, errors in identifying the characteristic of planar figure, and errors in interpreting story problems in mathematical form.

1. Introduction
Mathematics is the basis of existing knowledge of some parts such as algebra, geometry, statistics, and each part has character differences [1]. In addition, mathematics is a difficult and abstract lesson for students, so mathematics becomes a frightening lesson for students [2]. Therefore, mathematics learning must fulfill the competencies to be achieved such as the ability of students to understand a concept, speech, and relations in mathematics can be built optimally [3]. In line with that, the students need to have the good mathematical knowledge to face the future [4]. Therefore, mathematics learning can be developed to build students' ability in understanding mathematics which is one of the difficult and frightening lessons, so students have the good mathematical knowledge to face the future.

Mathematical understanding is an understanding of concepts, principles, and relationships between new knowledge and prior knowledge [3,5]. In addition, the conceptual understanding is also important in building students' knowledge that they already have [3]. Thus, mathematical understanding is a conceptual understanding to build new knowledge that students have.

Geometry is a field in mathematics that provides information about students' spatial thinking skills [6]. Correspondingly, studying geometry is an important component of mathematics learning because
it allows students to interpret and analyze their daily lives that can be applied to the field of mathematics [7]. In addition, many students lack knowledge about geometric shapes and their properties so that occasional errors occur in students [8]. Therefore, in studying geometry which is one of the fields in mathematics that can provide information about students' spatial thinking abilities that allow students to interpret and analyze geometric shapes and their properties that often occur in students' errors in geometry.

Mathematics learning is very important in understanding geometry and spatial reasoning, therefore spatial reasoning is the basis for mathematics and other learning [9]. In addition, [10] suggest that 60% of students have difficulty classifying four sides of objects such as square, rectangular, square, and rhombus. Then, students experience spatial errors such as the ability to visualize geometry [11-14]. This is supported by [12] suggesting that difficulties in visualizing geometry can affect students' mathematical abilities. next, it is necessary to develop and improve mathematical and spatial understanding skills [15]. Therefore, in mathematics geometry learning requires mathematical understanding and spatial ability.

The mistake that often occurs is that students only memorize geometry formulas without the understanding of a concept [16]. Therefore, student errors can be seen in problems solving that occur in learning [17]. Therefore student errors occur because students only memorize formulas so that they can be seen in students problems solving. So, the researcher want to find out the students difficulties in problems solving of geometry, especially in seventh-grade students. The aim of this research is to detect and describes the mistake made by students.

2. Method
This type of research is descriptive qualitative research which describe the misconceptions of seventh-grade students in solving geometry problem [7]. This research was conducted at SMP Negeri 2 Pundong, with the research subjects being seventh-grade students. The background to the selection of subjects with consideration is that geometric material has been studied by students at this level. Sources of research data are in the form of test results data and interview results. Interviews were carried out on mathematics teachers to see more about students' conceptual knowledge of geometry.

The research instrument used is a matter of geometry, especially how to answer questions in accordance with the concept. Interview guidelines are as an additional instrument in research. Test instruments are given in the form of national exam questions about geometry. The researcher used the national examinations questions because the questions were validated and relied on by the government. In addition, the national examinations questions have been used for the final school examinations to determine student graduation in Indonesia. Therefore, researchers use national examinations questions.

The results of the research data were analysed by referring to the students' understanding in solving problems. The focus of this research is the process of solving problems according to their mathematical concepts. Furthermore, the analysis of all data was carried out in 3 main steps, namely data reduction, exposure, and conclusion drawing [18].

3. Result and discussion
After analysis of the data test, the researcher find out three mistakes made by students in solving problems geometry type national examinations. The explanation three mistakes made by students, it can seen in Table 1.

| Table 1. type of mistakes made by students |
|------------------------------------------|
| Type of Mistakes                         | Frequency |
| errors in using of formula geometry      | 24         |
| errors in identifying the characteristic of the plane | 24         |
| errors in interpreting story problems in mathematical form | 18         |
Student errors will be discussed as follows. The mistake of using formula of geometry consists of 2 types with several possible reasons. For more information, it can be seen in Table 2.

**Table 2. Mistake using formula of geometry**

| Mistakes Made                      | Possible Reason                                                                 |
|------------------------------------|---------------------------------------------------------------------------------|
| Error using the rectangular formula | – Students understanding that the rectangle has a height.                        |
|                                    | – In applying the formula of the area \( (L) \) of a rectangle is \( L = p \times l \times t \) |
|                                    | – Lack of students’ mathematical understanding in using formula of the area rectangle |
| Error using the kite formula       | – Students experience errors in using the area and circumference formula.        |
|                                    | – Students look around from a kite by means of circumference \( (K) = 25 \times 10 = 250 \). |

The first mistake is using a rectangular formula where students use the area \( (L) \) of the rectangle formula \( L = p \times l \times t \), which \( p \) = length, \( l \) = width, and \( t \) = height are students assume that the formula of a rectangle has a high, and here we can find out that students still make mistakes in using the rectangular formula [7, 19]. It can be seen in Figure 1.

![Figure 1. Error in using formula of geometry](image)

The second mistake is identifying the characteristic of the plane. In this mistake, student is errors in identifying the characteristic of the plane. The possible reason for this mistake can be seen in Table 3.

**Table 3. Mistakes of in identifying the characteristic of the plane**

| Mistakes Made                          | Possible Reason                                      |
|----------------------------------------|------------------------------------------------------|
| Error identifying the characteristic of the plane | – Students cannot describe or imagine 2-D shapes. |
We can see that students make mistakes in identifying the properties of the Planar figure. In fact, the properties of the problem are parallelogram properties, but students answer that these properties are rectangular Planar figure properties [10, 20]. It can be seen in Figure 2.

**Figure 2.** Students cannot identifying the characteristic of the plane

The last mistake is interpreting story problems into mathematical forms. This mistake has three possible reasons that can be seen in Table 4.

| Mistakes Made                                                                                                      | Possible Reason                                                                                     |
|--------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| interpreting story problems into mathematical forms                                                              | Students’ understanding of the problem is 2 times the width of the rectangle is 2 × 2 = 4 for the square area. |
|                                                                                                                    | Students’ understanding of this problem when the area of a square is equal to 2 times the area of a rectangle is 32 × 32 = 1024 |
|                                                                                                                    | Lack of students’ in using formula area rectangles and squares made in story problems.              |

We can know for the formula the student already understands and does not experience errors in using the formula. However, when we look at the way the student answers the question, it appears that students have not been able to present the question in the form of mathematics. It is seen when the student answers on a wide area of a square [21]. In the picture above the student gives the answer that the area of the square is 2 so that the student multiplies 2 × 2 = 4 for the square area. Thus, it can be said that these students have not been able to present story problems to mathematical forms and lack understanding of mathematical logic. It can be seen in Figure 3.
Figure 3. Interpreting story problems into mathematical forms

The results of interviews with mathematics teachers at SMP Negeri 2 Pundong that in mathematics learning, teachers use the 2013 Revised 2016 curriculum. The approach used by teachers in learning is the scientific approach. In addition, the use of this approach is also mixed or combined with the lecture method, due to the lack of students' mathematical understanding which makes it difficult for them to accept the scientific approach. It is because when they are in elementary school, elementary school teachers still use the lecture method, so they are still familiar with the method of reflection. For example, such as when the teacher explains a problem to the student, but the student does not understand what is explained, then the math teacher must repeat again to explain the problem from the beginning again. In addition, the teacher in assessing the mathematical understanding of grade VII students is to give questions to students and see how they answer the questions. Therefore, when students can work on the given questions, it can be concluded that students have few understanding that explained by the teacher. It is seen in Dialogue 1.

Dialogue 1
Researcher: how do you rate them, rate that they understand the mathematical concept in what way?
Teacher: I usually give a problem, if they can work on the problem, then they few understanding with about what I explained.
Researcher: means to see students’ understanding by seeing how they answer questions.
Teacher: looking at the way they answer means that they are familiar with the concepts used.

The problem faced by the teacher is the problem of students in contextual, for example like a garden that is given a fence, then actually looking around, but students are still confused and difficult to identify what is actually asked. Thus, for students ‘spatial abilities are still low, this is due to the lack of students' understanding and reasoning in contextual form [10, 22]. It is seen in Dialogue 2.

Dialogue 2
Researcher: means there is also mixing with the lecture method too, Mrs?
Teacher: if for example pure with their scientific cannot yet, students’ reasoning ability is still lacking, for example, new discoveries to determine two lines are still difficult.
Researcher: how your experience teaching geometry Mrs?
Teacher: the student said he had a broad formula, it turned out that the volume and lengths were from there it seemed students were still confused.
Researcher: because when I researched I got that, like the rectangular formula they wrote $t$ and when they calculated the combined area it was still confused.

Teacher: well, sometimes they are also confused with traveling around the building and in contextual issues; they are also still confused about contextual issues.

Researcher: for example, Mrs?

Teacher: Suppose the circumference is given a fence, then actually looking around but they don't know what to look for.

Researcher: oh that means in contextual terms they are confused Mrs?

Teacher: yes, that is an example in everyday social life, Ms.

The lack of understanding and reasoning of students in contextual problems so that the teacher only trains students by working on the questions that exist [20-22]. Therefore, it can be concluded that grade VII students at SMP Negeri 2 Pundong are still relatively low. It is seen in Dialogue 3.

Dialogue 3
Researcher: what is the child's ability in mathematical understanding Mrs?

Teacher: if it's low here but you are not low or too low, Ms, being low is Ms, we suppose explaining the matter they don't understand we have to repeat. if we focus on one child we can't, it must be thorough, so we have to repeat it all.

Researcher: but when they are trained with questions can you Mrs?

Teacher: yes they have to drill with questions like that. for the level of understanding of the problems of everyday life is still lacking.

4. Conclusion
There are three misconceptions in solving the geometry problems for seventh-grade students. First, Students’ are errors in using formula of geometry. Second, they are errors in identifying the characteristic of the planar geometry. Lastly, they are error in interpreting story problems in mathematical form. Result would be the foundation or the best reason for researcher to design the learning trajectory on Geometry and implement the design in learning process to solve the problems for the future research.

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