

Students' Mathematical Understanding of Online Learning: Evaluation of Triangular and Rectangular Materials

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ABSTRACT

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The purpose of this research is to find out a comprehensive picture of students' mathematical understanding in the online learning process, especially in the triangle and quadrilateral material. The study was conducted on 20 students of junior high school. The qualitative research method was chosen. Interactive analysis is applied to obtain in-depth information related to interpreting research findings. Data collection is done by using zoom meeting. The research data are in the form of test scores for mathematical understanding abilities, observation sheets related to the online learning process carried out and in-depth interviews to determine students' mathematical understanding abilities. The results of the study showed that, out of 20 students, only 8 students scored 30 and 12 were below. The ability of students' mathematical understanding in the online learning process was still very poor, especially in the concept of triangles and quadrilaterals. Students' understanding is still limited to memorizing properties without understanding in detail the characteristics of each flat shape. Students still have difficulty in applying formulas to triangles and quadrilaterals in solving problems.



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A. INTRODUCTION

Mathematical understanding is one of the abilities that must be possessed and mastered by students. This ability is the basis for understanding and solving problems (Wahyuni et al., 2021). Mathematical understanding will make it easier for students to solve problems without having to remember the formula to be used (Sheftyan et al., 2018). So that mathematical ability becomes one of the goals that students must have in studying mathematics (Kusmaryono, 2014; Minarni et al., 2016; NCTM, 2000). This is also supported by several research results (Druken, 2021; Ivars et al., 2020; Marsudi et al., 2021; Noto et al., 2020; Wahyuni et al., 2021) which explain that studies related to mathematical understanding abilities are important concepts to be studied and developed.

The interaction that is built in the learning process is the key in students developing mathematical abilities. In an online learning environment, where the learning process is completely done virtually. This condition limits students in interacting directly with other

students and teachers (Marsudi et al., 2021), as in the current pandemic conditions. Although the online learning process has been known in the world of education in Indonesia, where the learning process is applied, students can still interact directly with other students and their teachers outside of class hours. This condition is different from the case of the COVID-19 pandemic, the limitation of community activities (PKM) implemented in Indonesia requires students to limit interacting directly (Khasanah et al., 2020; Mar'ah et al., 2020; Purwanto et al., 2020).

Changes in the learning environment that adapt to the COVID-19, have a psychological impact on students, especially in students' mathematical understanding (Khasanah et al., 2020; Mar'ah et al., 2020; Purwanto et al., 2020). This changing condition is also felt by students of junior high school. Based on the results of interviews with mathematics teachers, the average cognitive ability of students is less satisfactory in direct learning. In addition, students have an average lower-middle economic ability. This causes the online learning process to be difficult for students and teachers to live. So that tracing students' understanding ability becomes an important thing in evaluating the learning process that has been applied.

Tracing students' understanding ability becomes an important thing in evaluating the learning process that has been applied (Hikmah, 2017; Sheftyawan et al., 2018). This search will provide information in determining alternative strategies for improving the learning process, such as in online learning today. Some of the results of previous studies, only explain some alternative online media used in improving students' mathematical understanding during the pandemic (Marsudi et al., 2021; Wahyuni et al., 2021). However, no one has evaluated the process of mathematical understanding that students have obtained through the online learning process. Based on the explanation above, the purpose of this research is to find out a comprehensive picture of students' mathematical understanding in the online learning process, especially in the triangle and quadrilateral material.

B. METHODS

The research applies qualitative methods in answering research problems. The research subjects were 20 students of junior high school. The research instrument was in the form of a student's Mathematical Comprehension Ability Test on the material of quadrilaterals and triangles which consisted of 5 questions (indicators are presented in table 1), observations and interviews. Data collection is done by using zoom meeting. The research data are in the form of test scores for mathematical understanding abilities, observation sheets related to the online learning process carried out and in-depth interviews to determine students' mathematical understanding abilities. Interactive analysis was applied to obtain in-depth information related to interpreting research findings (Milles & Huberman, 2014). The analysis stages consist of data validity, data collection, data reduction, data presentation, and drawing conclusions (Daniati et al., 2019).

The analysis process is in the form of collecting data on the results of the mathematical reasoning ability test after studying the triangle and quadrilateral material. Data validation was in the form of interviews with students, to confirm the researcher's perception of the answers to students' mathematical reasoning ability tests. Data reduction, data presentation, and conclusion drawing were adjusted from the student's interview responses to answer the research questions that had been asked.

Table 1. Mathematical understanding indicator

Sub Material	Indicator	Question number
Properties of triangles and quadrilaterals	Identify the properties of squares and rectangles	1
Perimeter and area of triangle and quadrilateral	Problem solving related to the concept of rectangles, squares and triangles	2, 3, 5
Perimeter and area of the combined plane	Determine the perimeter and area of a composite shape	4

C. RESULT AND DISCUSSION

The purpose of this study is to find out a comprehensive picture of students' mathematical understanding in the online learning process, especially in the triangle and quadrilateral material. The data collection process begins with observing the learning process which was carried out for 8 online meetings using the zoom meeting application. Observations are made to ensure the learning process is in accordance with the learning steps, observing student responses in accepting the learning process. Furthermore, students were given a test of mathematical understanding ability on the material of triangles and quadrilaterals. The results of the student's mathematical understanding ability test were not very good. It can be seen that, the highest score is only 30 (8 students) and the others are below it (see Figure 1).

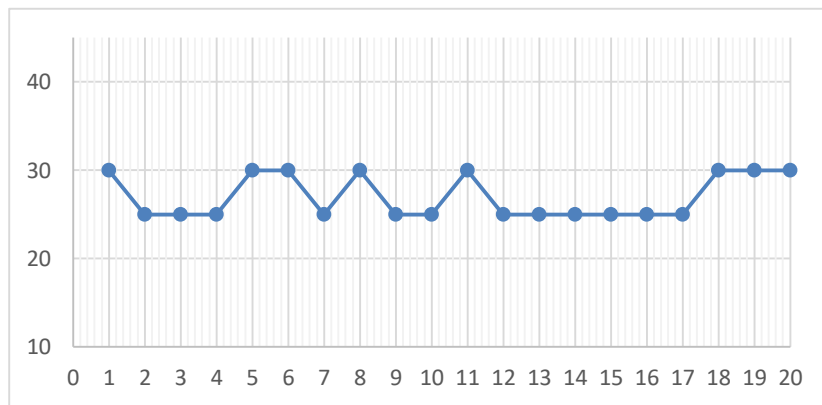


Figure 1. Mathematical reasoning ability score

Based on Figure 1, the researchers conducted in-depth interviews to determine students' understanding of triangles and quadrilaterals. The following presents one of the results of student responses (hereinafter coded S1) and interviews related to indicators on mathematical understanding abilities.

1. Properties of triangles and quadrilaterals

The first indicator, students are given problems to demonstrate their ability to identify the properties of squares and rectangles. In the answer to question number 1, the variation of student answers is very limited to identifying the properties of squares and rectangles. The following are the answers of S1 students for question number 1.

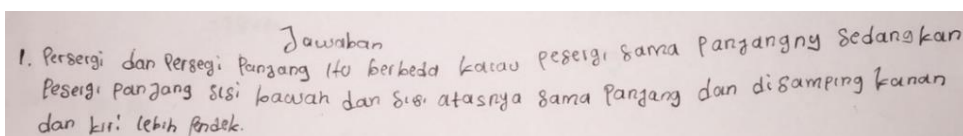


Figure 2. S1 students' answers to question number 1

Figure 2 shows the results of students' answers that are less varied. Students are only limited to an understanding of the basic properties possessed by squares and rectangles. Students have not been able to analyze the overall properties possessed by the two flat shapes. "Are all the properties contained in the rectangle owned by the rectangle?". This question is the key in understanding the statement. Limitations occur because of the learning process that occurs. Students are only given the basic properties of each flat shape, where students do not try to re-identify the similarities and differences of each given flat shape. Lack of understanding of the concept makes students make mistakes (Altıparmak & Gürcan, 2021; Hadi et al., 2018; Santoso et al., 2017). This finding is in line with the results of research (Andila & Musdi, 2020; Rizzika & Shofyan, 2021; Widiyaningsih, 2020) which states that students in understanding geometry are only limited to seeing abstract images and memorizing geometric shapes, without understanding the properties of the geometry being studied.

2. Perimeter and area of triangle and quadrilateral

The second indicator includes problem solving related to the concept of rectangles, squares and triangles. Student responses can be seen in the answers to questions number 2, 3 and 5. The answers of undergraduate students related to this second indicator are presented in the following Figure 3.

Figure 3. S1 students' answers to questions number 2, 3, and 5 (from left to right)

In Figure 3, students are asked to determine the area of a rectangle with a length of 12 cm and a width of 7 cm. S1 students in responding to this problem, do not write the area formula "Area = Length x Width". But using the concept of calculating the perimeter in solving problems. Although S1 students in completing do not also apply the perimeter formula "Perimeter = 2 (Length + Width)", where students solve it by describing each component and then adding them up at the end. Students still feel confused in applying these two formulas. On confirmation of the interview, S1 students expressed confusion in the application of the two formulas. S1 students still consider these two formulas the same, which involves multiplication and addition on the long side and the wide side (Van de Walle, J.A., Karp, K.S., & Bay-Williams, 2014). Instead of using the area formula, students assume the perimeter formula can solve problem number 2 (see Figure 3). These results indicate that the online learning process results in students' lack of understanding of concepts, this is in line with some findings in direct learning. Teachers need to focus on the concepts of perimeter and area, so that there is no confusion about the constant relationship between perimeter and area (De Sousa, J.R., Gusmão, T.C.R.S., Font, V., & Lando, 2020). Learning activities by focusing on explanations for what the formula is, or some activities that can strengthen the concept need to be carried out by teachers (Livy et al., 2012; Runnalls & Hong, 2019).

The same thing is also seen in the students' answers to question number 3 (see Figure 3). Students are asked to determine the height of a triangle whose area is 24 cm² with a base of 8 cm. This problem requires students' reasoning in determining the height of a triangle from a known area. However, from the answer sheet, S1 students have difficulty in determining the

height of the triangle. S1 students view area as width, instead of manipulating the area formula, S1 students do repeated additions to area, so that they get "Area = $24 + 24 = 48$ ". While the base is known to be 8 cm, undergraduate students view the base as length, then add up "Length = $8 + 8 + 8 = 24$ " considering that the triangle has three sides. The final result is expressed as the sum of the two previous operations, namely " $48 + 24 = 72$ ". Based on interviews, undergraduate students cannot see the relational concept of triangles. These results provide an overview of students having difficulty in determining the length of one side of a triangle with a known area. Students understand many concepts but cannot see the relational of these concepts (Sahin, 2015).

While in question number 5 (see figure 2), students are asked to determine the length of the side of a square with an area of 169 m^2 . S1 students' responses were still consistent in their errors in the previous 2 questions. S1 students again add up the known area "Area = $169 + 169 = 338$ ", and do the multiplication again on the known area "sketch = $169 \times 2 = 338$ " and at the end, S1 students add up the results of the previous addition and multiplication. Operations performed by S1 students, he did as a procedure in determining the length of the side of the square he was looking for. This error, he made because he was not able to determine the square root of a known area. S1 students explained that in practice questions in the learning process, they found it difficult to solve these types of questions. So that in the answer sheet to question number 5 (see figure 2), S1 students explain their answers like that. Students fail to understand the concept, so they make a conceptual error in determining the relational concept (Ferwinda & Syahrilfuddin, 1967; Hanifaturrochmah et al., 2020; Sahin, 2015).

3. Perimeter and area of the combined plane

The next indicator, determines the perimeter and area of the combined plane. The following are the results of the S1 students' responses to question number 4, which are presented in Figure 4.

The image shows two columns of handwritten mathematical work. The left column is for area calculations and the right column is for perimeter calculations.

Area Calculations	Perimeter Calculations
4. Panjang = $4 + 4$	keliling $25 + 25$
= 8	= 50
lebar = $2 + 2$	= $8 + 4 + 6 + 50$
= 4	= 68 cm
luas = $3 + 3$	
= 6	

Figure 4. S1 students' answers to question number 4

Based on Figure 4, S1 students find it difficult to identify ways to solve them. From the problem information, the length of side 8 and the length of side 4 are known, S1 students see that the two sides are the length and width, which is obtained from the sum of half of each given side length, obtained "Length = $4 + 4 = 8$ " and "width = $2 + 2 = 4$ ". So that the area of the flat building in question, he obtained from the addition of the length of the other side, namely "Area = $3 + 3$ ". In confirming the answer regarding the area of the flat shape obtained, the undergraduate students find it difficult to explain again, "why is the area smaller than the length and width?". For the perimeter, S1 students first determine the length of the hypotenuse. He remembers the combination of the Pythagorean triples, namely "3 4 and 5". But the mistake he made, took the length of the hypotenuse with its square value, which is "25". Next, he adds up " $25 + 25 = 50$ ". So that the perimeter of the figure is the sum of all the sides that have been obtained, namely " $8 + 4 + 6 + 50 = 68 \text{ cm}$ ". The concept of the perimeter

of a flat figure, he has applied even though he does not use a formula, but the error he made lies in determining which side is used to determine the perimeter of the figure in question. The concept of combined perimeter of flat shapes requires students to add up the sides of the combined flat shapes without including the overlapping sides. In contrast to the calculation of the area, where the decomposition of shapes into different shapes it will be easier to determine the area of the combined flat shapes (Ekawati et al., 2019; Nurwahid, 2021).

D. CONCLUSION AND SUGGESTIONS

The results of the study showed that, out of 20 students, only 8 students scored 30 and 12 were below. The ability of students' mathematical understanding in the online learning process was still very poor, especially in the concept of triangles and quadrilaterals. Students' understanding is still limited to memorizing properties without understanding in detail the characteristics of each flat shape. Students still have difficulty in applying formulas to triangles and quadrilaterals in solving problems. Seeing these results, the application of online learning strategies that can increase students' understanding needs to be applied, such as providing virtual worksheets or educational games that focus on identifying characteristics of properties and applying concepts to triangles and quadrilaterals. This study can serve as a basis for further research, considering that the focus of the research is limited to triangles and quadrilaterals.

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