Analysis of the Mathematical Concept Understanding Ability of VII Grade Junior High School Students

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Article Info	Abstract
	This study aims to analyze the mathematical concept understanding ability of seventh grade students at SMP Swasta Bhayangkari 3 Rantauprapat regarding the topic of two-dimensional quadrilaterals. The assessment of concept understanding focuses on determining the extent of students' abilities in solving problems related to mathematical concepts, using the following indicators: Understanding mathematical concepts includes the ability to define a concept both verbally and in writing, group objects based on certain properties, provide examples and counter-examples of a concept, present the concept in various forms of representation, and apply concepts or algorithms to solve problems. The research method used is descriptive qualitative, involving 24 students as research subjects. Data were collected through a concept understanding test consisting of 5 questions related to two-dimensional quadrilaterals. The results indicate that 8 students, or 33.3%, are categorized as having high understanding, 12 students, or 50%, are in the moderate category, and 4 students, or 16.6%, fall into the low category. Thus, the mathematical concept understanding ability of the students is considered to be quite good. The research results show that students' understanding of mathematical concepts still needs to be improved, especially in the ability to explain concepts, clarify the nature of objects, and present concepts in various representations. **Keywords:** Mathematical Concept Understanding, Two-Dimensional, Quadrilaterals , Junior High School Students.

1. Introduction

Mathematics is one of the core subjects taught in schools, but understanding its concepts is often a challenge for students, including in quadrilateral contexts, where general learning difficulties such as a lack of visualization, understanding the properties of shapes, and contextual application of concepts often hinder their ability. them in solving mathematical problems (Erlita & Hakim, 2022). A good understanding of concepts will make it easier for students to study mathematics further (Suraji et al., 2018).

Mathematical understanding is one of the goals that students should achieve effectively. Learning activities often place greater emphasis on memorization and obtaining answers, with students relying entirely on the teacher for solutions. However, students may lack

understanding because they are not critical thinkers, making it difficult for them to solve mathematical problems effectively. Therefore, understanding is essential in helping students learn how to think and make judgments. For children to develop effective problem-solving skills, mathematical understanding is necessary (Meilani et al., 2022)

One of the mathematical topics taught in seventh grade junior high school is quadrilateral shapes. This topic is important because the concepts associated with quadrilaterals serve as a foundation for studying other mathematical materials (Sumiati & Agustini, 2020). Mastering the concept of quadrilaterals is an important prerequisite in understanding further geometry, such as the relationship between geometric figures and the application of trigonometry, so that difficulties with this concept can hinder learning high-level mathematics material (Dewi, 2017). However, based on initial observations at Bhayangkari 3 Private Junior High School in Rantauprapat, students' understanding of concepts related to quadrilaterals is still low due to the continued use of conventional teaching methods.

Some students still struggle to differentiate the characteristics of each type of quadrilateral, such as squares, rectangles, trapezoids, and kites. Additionally, students face difficulties in solving problems related to quadrilaterals, particularly in determining area and perimeter.

The low level of students' understanding of mathematical concepts requires serious attention from teachers. A good grasp of concepts will facilitate students in further studying mathematics (Dirgantoro, 2018). Therefore, this study aims to analyze the mathematical concept understanding ability of seventh grade students at Bhayangkari 3 Private Junior High School in Rantauprapat regarding the topic of quadrilaterals.

Students' ability to understand mathematical concepts is one of the important aspects in mathematics learning. The concept in question includes an understanding of terms, facts, principles, and procedures in mathematics that allow students to apply these concepts in solving problems. One of the materials that is the focus of mathematics learning at the junior high school level is building a flat quadrilateral. This material includes different types of rectangles such as squares, rectangles, trapezoids, parallelograms, and rhombuses, each of which has its own unique characteristics and properties (Prasetyo, 2024).

Every material delivered by the teacher, because the teacher is the student's guide to achieve the expected concept. Seeing the importance of having mathematical comprehension skills, educators must design more innovative learning so that students achieve better learning outcomes. The ability to understand mathematics is an important aspect that needs to be considered in the learning process, especially to gain a deep and meaningful understanding in mathematics. Mathematical comprehension skills provide the meaning that there are two types of comprehension skills, namely: a) Instrumental comprehension refers to the ability to memorize information in isolation or apply it in simple routine calculations, as well as perform algorithmic steps sequentially. In this understanding, students only memorize formulas and follow the sequence of work and algorithms; and b) relational understanding which means being able to perform meaningful calculations on broader problems, containing schemes or structures that can be used in solutions that contain broader problems, being able to relate to other concepts/principles and the nature of its use is more meaningful (Tantowi et al., 2018).

According to NCTM (Melisari et al., 2020) Mathematical understanding includes seven main indicators that reflect students' abilities in various aspects. These indicators include the ability to define concepts both orally and in writing, classify objects based on certain

characteristics, and provide examples and counter-examples of a concept. These indicators reflect students' ability to understand concepts in depth, such as defining them correctly to demonstrate theoretical understanding, as well as providing examples and counterexamples to test the application of concepts in various practical contexts. Apart from that, students are also expected to be able to represent concepts through various forms, such as tables, graphs and diagrams, as well as compiling the necessary and sufficient conditions for a concept. This understanding also includes the application of concepts or algorithms in solving problems, to selecting and using certain procedures or operations appropriately according to needs.

This research focuses on several indicators of mathematical understanding, namely the ability to define concepts orally and in writing, classify objects based on certain properties, provide examples and counter-examples of concepts, represent concepts through various forms such as tables or diagrams, and apply algorithms in problem solving. Mathematics learning given to students is not only limited to memorization, but the emphasis on understanding is an important basis for studying mathematics. According to Nirmala, comprehension training in every learning activity can improve students' mathematical knowledge, which has a significant impact on their ability to solve problems. As a result, it is expected that students' ability to convey well-understood and accurate concepts will improve with comprehension whenever they encounter problems in mathematics learning. One of the materials that is considered difficult is geometry which has triangular and rectangular submaterials. The difficulties of a number of problems include the absence of proper strategic selection of learning materials and restrictions on the use of teachers' learning media that facilitate the transmission of information (Meilani et al., 2022).

Bhayangkari 3 Rantauprapat Private Junior High School is one of the schools that pays special attention to the development of students' ability to understand mathematical concepts, especially in quadrilateral flat building materials. This study aims to analyze the ability of grade VII students to understand and apply the concept of quadrilateral flat building. It is hoped that the findings of this research can contribute to the development of effective and relevant learning strategies, both theoretically to enrich the study of mathematics education and practically to increase students' understanding of the concept of quadrilaterals.

2. Methods

This type of research is qualitative research with a descriptive approach (Sugiyono., 2015). A qualitative descriptive approach was chosen to explore students' understanding in depth through observation, interviews and documentation. This research aims to describe the ability of students to understand mathematical concepts on quadrilateral flat building materials.

This research was carried out at Bhayangkari 3 Rantauprapat Junior High School which is located at Jln. T. Cik Di Tiro, Rantau Prapat, North Rantau District, Labuhan Batu Regency, North Sumatra Province. The time for conducting the research is June in the even semester of the 2023/2024 school year. The research subjects were chosen from class VII students because they were in accordance with their stage of cognitive development in understanding basic geometric concepts, especially quadrilaterals, as well as considering their initial abilities and academic background.

The subjects taken by 24 students were given test questions related to the ability to understand mathematical concepts on rectangular flat building materials to find out how far their understanding of mathematical concepts is.

In order to collect research data, data was collected in the form of an instrument to test the ability to understand mathematical concepts. The test instrument is designed based on the curriculum and literature, includes indicators that define, classify, and provide examples and counterexamples. Validation was carried out by educational experts to assess the suitability of the content, followed by limited testing to ensure the reliability and accuracy of the data. Tests are carried out in a structured manner in the classroom with specially allocated time, ensuring that all students work under uniform conditions to maintain fairness and consistency of results.The data from the instrument provided is in the form of test results which are then analyzed and concluded. After the conclusion of the test instrument results is known, a description of how far the student's ability to understand mathematical concepts will be obtained.

The score obtained is used to determine the level of understanding of students and choose the answer to be used in the research.

Table 1. Interval Category of Ability to Understand Mathematical Concepts

Interval	Category
$x >$ (Mean + SD)	High
(Mean − SD) ≤ x ≤ (Mean + SD)	Medium
$x <$ (Mean − SD)	low

Categorization of grades in students can be done by looking for the mean and standard deviation. Students' conceptual understanding is categorized as high if their scores exceed the average plus standard deviation. Students are in the medium category if their scores are between the high and low categories. Meanwhile, the low category is determined if the student's score is less than the result of subtracting the average from the standard deviation.

3. Result and Discussion

Result

The research carried out produced findings regarding the test results of students at Bhayangkari 3 Rantauprapat Private Middle School regarding understanding of mathematical concepts in rectangular shapes, which illustrates the level of students' ability to understand mathematical concepts.

Table 2. Results of the Students' Mathematics Concept Comprehension Ability Test

Number of Students	Maximum Score	Minimum Score	Average	Standard Deviation
24	16	0	10,54	2,27

Then the scores obtained from the students' answers were analyzed and categorized.

Table 3. Categories of Students on the Ability to Understand Mathematical Concepts

Categories	Value criteria	Number of Students	Percentage
High	$x > 12{,}81$	8	33,3%
Medium	$8{,}27 \leq x \leq 12{,}81$	12	50%
low	$x < 8{,}27$	4	16,6%

The following is the data on the results of the students' answers grouped by gender:

Skills in understanding mathematical concepts of male students

Table 4. Results of the Test of Understanding Mathematical Concepts of Male Students

Categories	Value criteria	Number of Students	Percentage
High	$x > 12{,}81$	4	16,6%
Medium	$8{,}27 \leq x \leq 12{,}81$	7	29,16%%
low	$x < 8{,}27$	1	4,16%

Based on Table 4 which presents the results of the test of the ability to understand mathematical concepts of male students in grade VII of Bhayangkari 3 Rantauprapat Private Junior High School, it can be seen that: In the High Category there are 4 students, namely 16.6% who have a score above 12.81. In the Medium category, there were 8 students, namely 29.16%, in the range of 8.27 to 12.81. In the Low Category, only 1 student, namely 4.16%, got a score below 8.27.

Skills in understanding mathematical concepts of female students

Table 5. Results of the Mathematics Concept Comprehension Test for Female Students

Categories	Value criteria	Number of Students	Percentage
High	$x > 12{,}81$	4	16,6%
Medium	$8{,}27 \leq x \leq 12{,}81$	5	20,83%
low	$x < 8{,}27$	3	12,5%

Based on Table 4, the results of the math concept comprehension ability test of female students at Bhayangkara 3 Rantauprapat Private Junior High School show the distribution of scores as follows: High Category (x > 12.81): 4 students are 16.6%. Medium Category (8.27 ≤ x ≤ 12.81): 4 students, namely 20.83%. Low Category (x < 8.27): 3 students i.e. 12.5%.

Ability to Explain Concepts Verbally and in Writing

Table 6. Analysis of Ability to Explain Concepts Verbally and in Writing

Score	Number of Students	Percentage
4	0	0 %
3	8	33,3 %
2	15	62,5 %
1	0	0 %
0	1	4,16 %

Based on the analysis of the table of 5 indicators of the ability to explain concepts verbally and in writing, it can be seen that out of 24 students, only 8 students (33.3%) obtained a score of 3, while 15 students (62.5%) received a score of 2. No student achieved a score of 4, and 1 student (4.16%) got a score of 0. These results show that the majority of students are still at a less than optimal level of understanding in explaining the concept of quadrilateral flat buildings.

Ability to clarify objects according to certain properties

Table 7. Analysis of the ability to clarify objects according to certain properties

Score	Number of Students	Percentage
4	0	0 %
3	0	0 %
2	23	95,8 %
1	0	0 %
0	1	4,16 %

Based on table 6 presented regarding the ability to clarify objects according to certain properties, it can be seen that the majority of students (95.8%) obtained a score of 2, which shows that they are only able to identify some properties of objects without being able to explain or clarify in depth. Meanwhile, only 4.16% of students got a score of 0, which indicates limitations in their abilities.

Ability to Give Examples and Non-Examples of a Concept

Table 8. Analysis of the Ability to Give Examples and Non-Examples of a Concept

Score	Number of Students	Percentage
4	9	37,5 %
3	0	0 %
2	0	0 %
1	0	0 %
0	15	62,5 %

From the table displayed, it is noted that out of a total of 24 students, 9 students (37.5%) succeeded in providing examples and counter-examples of a concept with a perfect score of 4. On the other hand, 15 students (62.5%) got a score of 0 , which hints them at providing the right example. No student obtained a score of 1, 2, or 3.

Ability to present concepts in various representations

Table 9. Ability analysis to present concepts in various representations

Score	Number of Students	Percentage
4	0	0 %
3	2	8,3 %
2	12	50 %

1	9	37,5 %
0	1	4,16 %

Based on the table presented, students' ability to present concepts in various representations shows a varied distribution of scores. Out of a total of 24 students, only 2 students (8.3%) got a score of 3, while the majority of students, namely 12 students (50%), got a score of 2. This shows that most students are at a level of understanding that is still quite low.

Ability to Apply Problem-Solving Concepts or Algorithms

Table 10. Analysis of Ability to Apply Problem-Solving Concepts or Algorithms

Score	Number of Students	Percentage
4	19	79,16 %
3	0	0 %
2	1	4,16 %
1	0	0 %
0	4	16,6 %

The data show that the majority of students, 79.16% (19 students), managed to achieve a score of 4 in the ability to apply concepts or problem-solving algorithms, indicating a good understanding in this aspect. However, there were 16.6% (4 students) who scored 0, indicating significant difficulty in understanding or applying algorithms. Interestingly, no students scored 3 or 1, and only 4.16% (1 student) scored 2, indicating a polarization of ability where students tended to be in the very good or very low categories without an even distribution at the middle level. This pattern may reflect the success of the learning method for the majority of students, but also underscores the need for special attention to the small group of students who are lagging behind, perhaps due to lack of engagement, gaps in basic knowledge, or other learning factors.
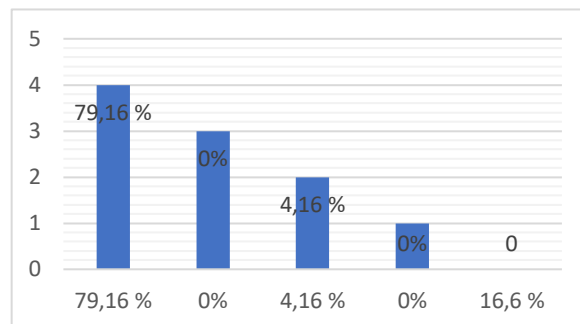

Chart 1. Analysis of Ability to Apply Problem-Solving Concepts or Algorithms

Discussion

Based on the results of the mathematical concept understanding ability test of male students, it can be seen that 16.6% (4 students) are in the high category with a score above 12.81. As many as 29.16% (8 students) are in the medium category with a score between 8.27 and 12.81, and only 4.16% (1 student) is in the low category with a score below 8.27. Meanwhile, female

students show a slightly different distribution: 16.6% (4 students) are in the high category, 20.83% (4 students) in the medium category, and 12.5% (3 students) in the low category. This difference in distribution indicates that female students have a greater proportion of the low category than male students, which may indicate gender factors or learning characteristics that affect the results. Analysis of the indicators of the ability to explain concepts orally and in writing shows that most students (62.5% or 15 students) scored 2, reflecting limited ability to explain. Only 33.3% (8 students) were able to score 3, while no students scored 4. As many as 4.16% (1 student) even scored 0, indicating serious difficulties in explaining the concept. This finding confirms that students still need intensive guidance in developing in-depth oral and written skills related to the concept of quadrilaterals. These results are in line with previous research that shows that students' understanding of mathematical concepts is often affected by less supportive teaching and learning environments (D. Sari & Kawan, 2020). This study is different from the study that found that female students have a better understanding of the concept than male students, with 38.46% of female students achieving a very good conceptual understanding category, while 62% of male students are in the very low category (Azizah et al., 2022). research that shows that female students are superior in understanding mathematical concepts than male students (Eva Julyanti, 2023).

The results of the study showed that most students (95.8% or 23 students) were only able to identify some of the properties of an object, with the highest score on this indicator being 2. This shows that although students can recognize some basic characteristics of quadrilaterals, they have difficulty in providing in-depth explanations of these properties. Conversely, 4.16% (1 student) were unable to identify any properties, indicating the need for a more concrete and targeted learning strategy. On the indicator of the ability to convey concepts through various representations, most students (50% or 12 students) scored 2, indicating that they were only able to use basic representations to convey concepts. Research by (Putri, 2021) shows that the use of active learning comprehension can significantly improve students' understanding of concepts. Only 8.3% (2 students) scored 3, while the rest were at a low level of understanding. This finding suggests that students need more practice using various forms of representation, such as diagrams, graphs, or verbal descriptions, to support their understanding. Students' ability to apply concepts or problem-solving algorithms showed more promising results, with 79.16% (19 students) scoring 4. However, there were 16.6% (4 students) who scored 0, indicating that there was still a small group of students who had difficulty understanding the basics of applying concepts. The absence of students scoring 3 or 1 indicates that there is a gap in the level of understanding that may need to be adjusted with more varied learning methods. The results of this study indicate that although most students are able to understand basic concepts and apply algorithms, there is still a gap in the ability to explain and represent mathematical concepts. To improve students' overall understanding, a more holistic learning approach is needed, such as the use of visual media, problem-based learning, and individual mentoring. In addition, strengthening mathematical communication skills, both verbally and in writing, is a priority to overcome obstacles to the indicator of deep understanding.

4. Conclusion

Based on the research findings and analysis that have been carried out, it can be concluded that the ability to understand mathematical concepts of class VII students at Bhayangkari 3 Rantauprapat Private Middle School on rectangular plane shapes shows that not all indicators of understanding mathematical concepts have been achieved well. Some indicators are still not fulfilled optimally. The level of understanding of mathematical concepts from 24 students, 8 students of 33.3% were in the high category consisting of 4 male students and 4 female students. There are 12 students of 50% in the medium category consisting of 7 male students and 5 female students. And there were 4 students of 16.6% in the low category consisting of 1 male student and 3 female students. That way, the ability to understand mathematical concepts possessed by students is quite good. The research results show that students' understanding of mathematical concepts still needs to be improved, especially in the ability to explain concepts, clarify the nature of objects, and present concepts in various representations.

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