e-ISSN: 2808-8263
p-ISSN: 2829-0976

Analysis of Mathematical Concept Understanding Ability of Grade IV Elementary School Students

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Abstract. The background of this research is because the mathematical concept understanding ability of elementary school students is low. So, the purpose of the research is to analyze and describe the mathematical concept understanding ability of students on the topic of square and rectangle area. In addition, the factors causing the low mathematical concept understanding ability will be collected. This type of research is descriptive research conducted in one of the public elementary schools in Tanjungsiang District, Subang Regency in the 2024/2025 academic year. The research subjects used were 20 fourth grade elementary school students. The results showed that students' mathematical concept understanding ability on the concept of square and rectangle area was in the low category in 3 indicators, namely 35% of students who were able to restate concepts that had been learned, 26% of students were able to apply concepts algorithmically, and only 25% of students were able to apply concepts to problem solving. Meanwhile, 60% of students have been able to classify objects based on whether or not the prerequisites to form the concept are met. In addition, researchers found four factors that cause low mathematical concept understanding ability.

Keywords: mathematical concept understanding ability, square and rectangle area

How to Cite: Indriani, N. Y., & Wahyudin. (2025). Analysis of mathematical concept understanding ability of Grade IV elementary school students. *The 7th International Conference on Elementary Education,* 7(1), 576-589.

INTRODUCTION

The purpose of education mandated in Law Number 20 of 2003 is to have religious spiritual strength, self-control, personality, intelligence, noble character, and skills needed by himself, society, nation and state. Based on these objectives, education is not only organized through the provision of a number of information or knowledge and the formation of skills. According to Rahman et al. (2022) education is interpreted as an effort made with the aim of realizing the desires, needs and abilities of individuals so that personal and social life patterns are formed that are useful for the present life of students who are experiencing the development of maturity and preparation for life in the future. This educational goal can be achieved if students experience the learning process. Charli et al. (2019) explain the meaning of learning, namely changes resulting from a process that is permanent and comprehensive as an individual response to certain situations. The changes shown are not only related to students' cognitive, but there are changes in the aspects of skills, skills, attitudes and behavior as well as the way students view things, character, and so on. Herawati (Herawati, 2018) added that changes in behavior or appearance in students who learn occur through their experiences after participating in activities such as observing, reading, imitating, experimenting, listening, and following instructions from the teacher during learning.

One of the subjects that students learn in elementary school is mathematics. Mathematics is taught at every level of education from elementary school to college. The materials in math lessons are activities that humans do in everyday life. For example, counting in marching activities, adding 10 grams of sugar to a glass of warm tea, dividing a watermelon into 12

equal parts, and calculating the difference in the number of male and female students in X elementary school. Therefore, learning mathematics must depart from the problems that students usually encounter. According to Sohilait (2021), it is important for students to learn mathematics by linking mathematical concepts and daily experiences. Students who learn by linking mathematical material with everyday life, they will get meaningful learning. In contrast to students who learn math separately from their daily experiences, they will forget quickly so they cannot apply math in their lives.

The purpose of implementing mathematics education in Indonesia is to form students who have a mathematical mindset (Andriliani et al., 2022). This mathematical mindset refers to the way students think that is logical, rational, critical, careful, honest, efficient and effective. The learning objectives of mathematics contained in the 2013 Curriculum Appendix 3 Permendikbud No. 58 are: (1) Understanding mathematical concepts, namely student competence in explaining the interrelationships between concepts and using concepts and algorithms flexibly, accurately, efficiently, and appropriately in problem solving, (2) Using patterns as conjectures in problem solving, and being able to make generalizations based on existing phenomena or data, (3) Using reasoning on properties, performing mathematical manipulation both in simplifying and analyzing existing components in solving problems, (4) Communicate ideas, reasoning and be able to compile mathematical evidence using complete sentences, symbols, tables, diagrams, or other media to clarify the situation or problem, (5) Have an appreciation for the use of mathematics in life, namely having curiosity, attention, and interest in learning mathematics, as well as a tenacious and confident attitude in problem solving, (5) Having an appreciation for the usefulness of mathematics in life, namely having curiosity, attention, and interest in learning mathematics, as well as a tenacious and confident attitude in problem solving, (6) Having attitudes and behaviors that are in accordance with the values in mathematics and its learning, such as principle, consistent, upholding agreement, (6) Have attitudes and behaviors that are in accordance with the values in mathematics and its learning, such as principle, consistent, upholding agreements, tolerant, respectful of others' opinions, polite, democratic, resilient, resilient, creative, respect for universality (context, environment), cooperation, fair, honest, thorough, careful, flexible and open attitude, willingness to share feelings with others, (7) Use simple props and technological products to carry out mathematical activities. Although not stated directly, communication skills appear and are needed in various skills, for example to explain ideas in conceptual understanding, present formulations and problem solving, or express arguments in reasoning. From these seven objectives, it can be seen that one of the objectives of learning mathematics is to have the ability to understand mathematical concepts.

Students with good concept understanding have the ability to solve problems in mathematics lessons. This statement is in accordance with Jacques' opinion (Radiusman, 2020) regarding mathematics as a hierarchical subject where the concepts learned on a topic are a continuation of the previous topic, meaning that students can only understand mathematical material if they have mastered the material on the previous topic. According to Aledya (2019) students who have an understanding of mathematical concepts are students who are able to develop problem solving strategies, use simple calculations, utilize symbols to represent a concept, and convert one form to another. Concept understanding ability is a level of thinking that is higher than memory or memorization. So, Yolanda (2020) categorizes students with good concept understanding based on their ability to organize and re-explain the concepts they have learned. The presentation confirms that in learning mathematics, students' ability to understand a concept is very important, namely as a condition for themselves to master the next material and solve problems both within the scope of mathematics lessons and real life.

However, the facts in the field show that there are many students who are not interested in learning math because they view the material in math lessons as abstract science (Putri et al., 2024). Likewise, in a study conducted by Permatasari (2021), many students revealed that math is difficult, complicated, confusing, and makes their heads dizzy, causing students to feel lazy to learn math. The results of Tahir and Marniati's research (2021a) showed that 23 out of 54 fifth grade students had concept understanding skills in the very low category, this was because students had difficulty understanding the problems presented in the problem. Another research by Tahir and Marniati (2021b) stated that the average score of grade V students' evaluation results had not reached the KKM or minimum completeness criteria due to low concept understanding ability. The majority of students are weak in the indicator of applying concepts or algorithms in problem solving. Verina and Darhim's research (2023) also showed that students' mathematical concept understanding ability on the topic of rectangles was still low. It was characterized by 19 students, one student only understood three indicators, 10 students mastered two indicators, seven students mastered one indicator, while one other student did not master any indicators. Based on the background description above, it is necessary to conduct a study to analyze the mathematical concept understanding ability of elementary school students.

METHODOLOGY

This research uses descriptive research. Descriptive research is a method that is carried out by providing an explanation of the research without manipulating the variable data under study through direct interviews (Hanyfah et al., 2022). Descriptive research type aims to explore and classify a phenomenon or social reality through describing variables related to the problem

being studied (Zellatifanny & Mudjiyanto, 2018). The subjects of this study were 20 fourth grade students in one of the public elementary schools in Tanjungsiang District, Subang Regency in the academic year 2024/2025. Determination of respondents is based on the results of the mathematical concept understanding ability test where the test scores are sorted from the highest to the lowest rank. Then the researcher determines the respondents using the proportionate stratified random sampling technique, which is a technique of taking samples from each stratum proportionally randomly (Matahelumual et al., 2020). Respondents were selected from each of the two students who obtained the highest score and the lowest score to be interviewed by the researcher.

The data collection techniques applied during the research process are as follows.

1. Mathematical Concept Understanding Ability Test

The test given is a test with a total of 6 essay questions on the area of square and rectangle material. This test was prepared based on the objectives in the learning outcomes of the measurement element on area and indicators of mathematical concept understanding ability. Indicators of mathematical concept understanding ability used in this study are: (1) restate concepts that have been learned, (2) classify objects based on whether or not the requirements to form the concept are met, (3) apply concepts algorithmically, and (4) apply concepts to problem solving.

2. Interview

The interviews conducted in this study were semi-structured interviews. This type of interview is included in the in-depth interview category, which is a freer interview when compared to structured interviews. The purpose of conducting interviews is to explore more specific problems found in the field. The formulation of interview material is based on the results of the mathematical concept understanding ability test related to the scores obtained and the factors that cause difficulties experienced by students in doing the test.

3. Documentation

This research uses documentation techniques in the form of photos and video recordings during interviews.

Researchers used triangulation techniques to test the validity of the data. Triangulation can be interpreted as a data analysis approach that synthesizes data from various sources (Susanto, 2013). In the research conducted, researchers compared the data obtained from test results, interviews, and documentation of research subjects. The three data were then analyzed descriptively using words that could describe the research results.

The data that has been collected is then analyzed with the Miles & Huberman model (Asipi et al., 2022). The following are the stages of data analysis of the Miles & Huberman model.

1. Data Reduction

The data reduction stage in this study is to summarize the test results and interview results.

2. Data Presentation

The test data is presented in the form of a table of values and percentages according to the indicators of the ability to understand mathematical concepts. While the interview data is presented in written form.

3. Drawing Conclusions

Researchers will draw conclusions by comparing test data and interview results. The test results will be strengthened by the interview results so that researchers can get an overview of the ability to understand students' mathematical concepts. In addition, researchers will also find out the factors that cause the low mathematical concept understanding ability of fourth grade elementary school students.

RESULTS AND DISCUSSION

The results showed that the ability to understand mathematical concepts of fourth grade students in one of the State Elementary Schools in Tanjungsiang District, Subang Regency in the 2024/2025 academic year was in the low category, namely in three indicators out of four indicators tested by researchers.

Table 1. Percentage of Mathematical Concept Understanding Ability

Indicator of Mathematical Concept Understanding Ability	Percentage	Interpretation
Restate concepts that have been learned	35%	Low
Classify objects based on whether or not the prerequisites to form the concept are met	60%	Moderate
Apply concepts algorithmically	26%	Low
Applying concepts to problem solving	25%	Low

Based on Table 1, 35% of 20 students are able to restate concepts that have been learned, 60% of students are able to classify objects based on whether or not the prerequisites are met to form the concept, 26% of students are able to apply concepts algorithmically, and only 25% of students are able to apply concepts to problem solving.

Furthermore, researchers analyzed students' answers to find out the factors that influence the low ability to understand mathematical concepts will be discussed through photos that represent the answers of the research subjects as follows.

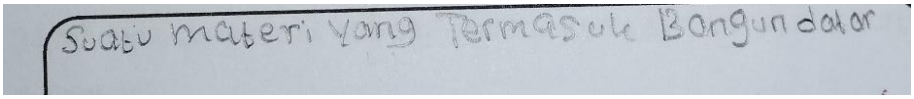

Figure 1. Students' Answers on Problem Number 1

Problem number 1 is based on the indicator of restating concepts that have been learned. To measure students' ability on this indicator, students were asked to mention the definition of area. The question for question number 1 is “What is the definition of area?”. Figure 1 is one of the student answers to question number 1. Students have not been able to restate the concept of area as evidenced by the student's answer in Figure 1, which is a material that includes flat buildings. It is likely that the answer is written by students based on their learning experience gained when learning mathematics on the topic of area.

In general, the discussion of the concept of area in elementary school math lessons always uses various forms of flat shapes such as squares and rectangles. So that students' understanding of area is part of flat shapes. Unaenah et al. (2020) define flat shapes as two-dimensional shapes that have length and width and do not have height and thickness. Referring to this definition, because flat shapes have two important elements in area, namely length and width, it is common for the topic of area discussion to use flat shapes. But it must be known that area is not a flat shape, but the area of a place or surface of an object is expressed by the number of units of area that cover the place or surface of the object without gaps.

The answers in Figure 1 also show that students have weak instrumental understanding. Skemp (Hermawan et al., 2021) states that there are two types of mathematical understanding, namely (1) instrumental understanding is a mathematical understanding in which students memorize something separately and are able to apply it in a routine or simple calculation in other words students are able to solve problems according to algorithmic rules and (2) relational understanding is a mathematical understanding in which students can perform calculations on more complex problems. Based on the results of the interview, the weak understanding of this concept is due to students' perceptions of mathematics as a difficult subject. This statement is in accordance with research conducted by Indofah and Hasanudin (2023) on students' perceptions of mathematics, namely: (1) students who are smart in mathematics have a natural talent in the field of mathematics, (2) students who are not confident do not have the motivation to learn mathematics, (3) students have difficulty

connecting mathematical concepts with real life, (4) students feel depressed when they have to memorize complex mathematical formulas, (5) students feel doubt and worry when working on math problems because the formulas in mathematics are interrelated, and (6) students feel depressed if there are students who do math problems quickly.

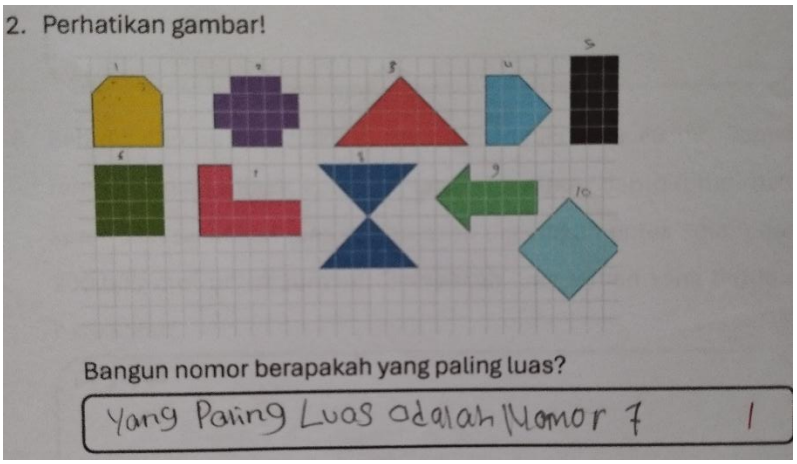

Figure 2. Students' Answers on Problem Number 2

The formulation of question number 2 is based on the indicator of classifying objects based on whether or not the prerequisites to form the concept are met. This indicator is measured using a problem that presents 10 flat shapes with different areas presented on a paper sheet and then students are asked to determine the widest flat shape. However, one of the students' answers shows that the answer is not correct, this can occur because students are less careful in calculating the area of each flat shape. In the research of Cahyanti et al. (Cahyanti et al., 2021), it was found that the factors causing students' errors in calculating and understanding concepts were because students did not understand the problems given and were not careful in working on the problem. The results of analyzing students' answers to question number 2 were reinforced by students' statements which stated that if one of their friends finished the test faster, they were provoked to immediately complete the test. As a result, students work on problems in a hurry which causes their answers to be wrong.

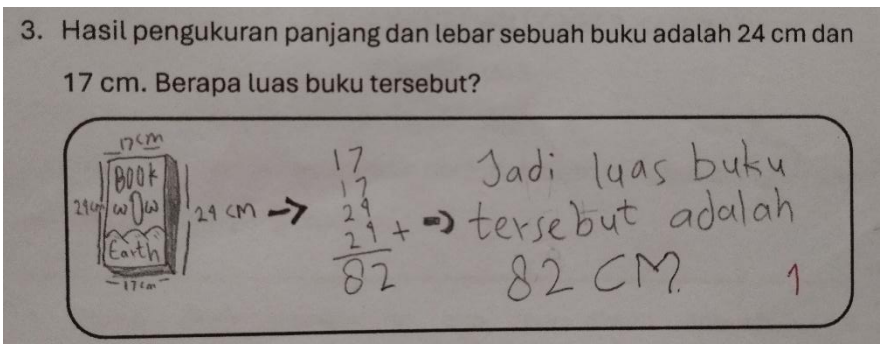

Figure 3. Students' Answers on Problem Number 3

Problem number 3 was created using the concept understanding indicator, namely applying concepts algorithmically. The indicator of this question asks students to calculate the area of a rectangle if the long side and the wide side are known. However, the answers given by students are not correct, based on Figure 3 the method or formula used by students is the formula for calculating the perimeter. According to Kenney and Kouba (Rosmini, 2020), a common mistake that many students make in calculating area and perimeter is confusing the area and perimeter formulas. During the interview session, students stated that the area formula that they had understood was wrong. Students mentioned that the area formula is the sum of all side lengths of a flat shape. This mistake can occur because generally, mathematics learning on the material of the area of quadrilateral flat shapes only trains students to use the area formula in working on mathematical problems without providing an understanding of how the formula is obtained (Sriaryaningsyih & Mulyadin, 2022).

Problem number 3 is in the form of a story problem where answering this problem requires students' ability to read comprehension and broad concept understanding. Learning activities that do not link the subject matter with real life will have an impact on the low ability to understand concepts. Nurhayati et al. (2020) explained that learning that facilitates students to connect subject matter with the context of students' lives will help them get used to understanding and linking between mathematical concepts so that students' understanding of mathematical concepts can last long. In addition, the student's answer in Figure 3 above also provides information that the student could not understand the meaning of the question so that he was wrong in using the formula to calculate the area.

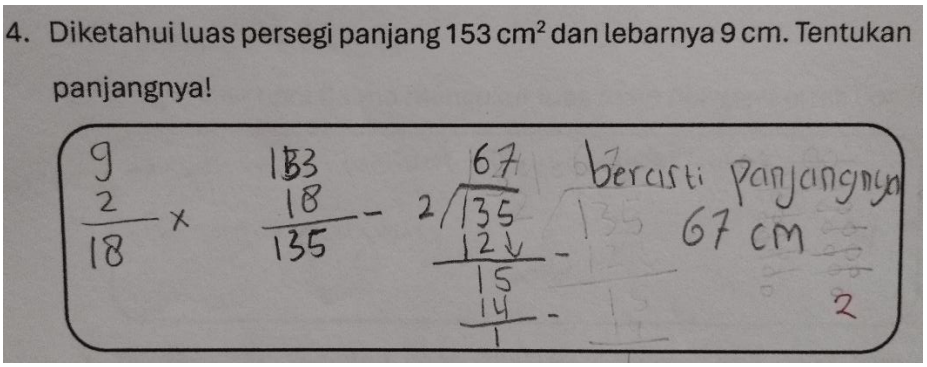

Figure 4. Students' Answers on Problem Number 4

Problem number 4 was also prepared with the indicator of applying concepts algorithmically. Unlike the previous problem, this problem asks students to find the length of a side of a rectangle if the area and width are known. There is a misconception of students' understanding of the area of a rectangle, students' answers show that students understand the concept of the perimeter of a flat shape as the concept of the area of a flat shape. The analysis of these answers is in accordance with the answers of students who think that the area formula is (2 x

length) + (2 x width). This is evidenced by the first step taken by students, namely multiplying the width of the rectangle and 2, namely 9 x 2 = 18. Then subtracting the area and width where students' understanding of the perimeter is used in working on the area problem, namely 153 - 18 = 135, then students divide 135 by 2 equals 67 cm.

A wrong understanding of the concept of flat area has an impact on student errors in applying the formula for finding the length of the side of a rectangle to the problems presented in the story problem. Regarding the errors in students' answers to problem number 4, Rohmah (2020) in her research states that there are three mistakes that students often make in working on math problems, namely (1) concept errors due to students not understanding the concepts or subject matter that will be used in working on problems, (2) principle errors are student errors in applying mathematical formulas in accordance with the problems given, (3) errors in understanding the language of the problem occur because students misunderstand the meaning of the problem and generally this error occurs when working on story problems. Referring to the results of this study, it can be seen that students in working on problem number 4 made three mistakes, namely errors in understanding the concept of flat area, errors in using the area formula, and errors in understanding story problems.

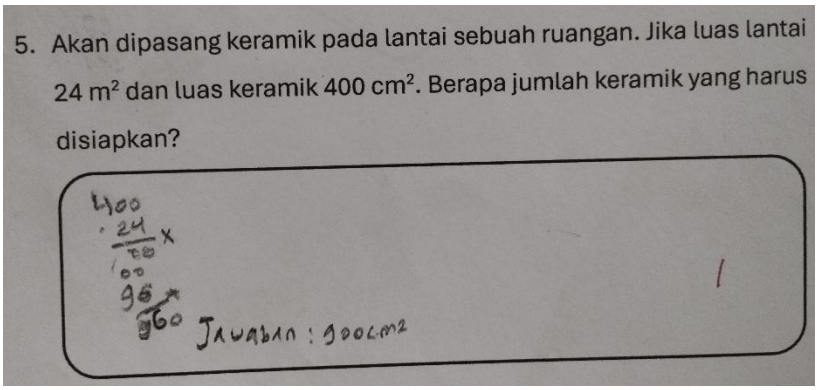

Figure 5. Students' Answers on Problem Number 5

The preparation of question number 5 is based on the indicator of applying concepts to problem solving. Measurement of concept understanding ability on this indicator is used as an indicator of solving problems related to area. To solve problem number 5, students must have the ability to read comprehension, understand the concept of area, use problem solving strategies, and convert area units from m^2 to cm^2. If these four abilities are possessed by students then they can determine the number of ceramics that must be prepared.

Based on Figure 5, students have not been able to apply concepts to problem solving. Interviews conducted with students mentioned that students are not used to working on non-routine problems. Non-routine problems are problems that present problems where the solution requires more complex thinking because the problem solving procedure is different

from the procedures that students usually learn in class. It can be seen from the student's answer that multiplying 400 and 24 results in 960. According to Subaidah (Muzaky, 2017) there are three types of errors made by students in solving math problems, namely: (1) mathematical concept errors are errors in using concepts related to material such as student errors in understanding the intent or meaning of the problem, (2) mathematical principle errors are errors related to the relationship between two or more objects in mathematics such as student errors in using mathematical formulas, (3) operation errors are errors in performing calculations such as student errors in mathematical operations. Referring to this opinion, there are three mistakes made by students in answering question number 5, namely mathematical concept errors where students misunderstand the meaning of the problem. Second, the mathematical principle error is the student's error in using the calculation operation, the student should have done the division calculation operation but the student did the multiplication operation. The third error is an operation error, as seen from Figure 5 which shows students incorrectly performing stacked multiplication. This error occurs because students do not understand the concept of stacked multiplication and it can be said that students have not been successful in learning mathematics (Damayanti et al., 2021).

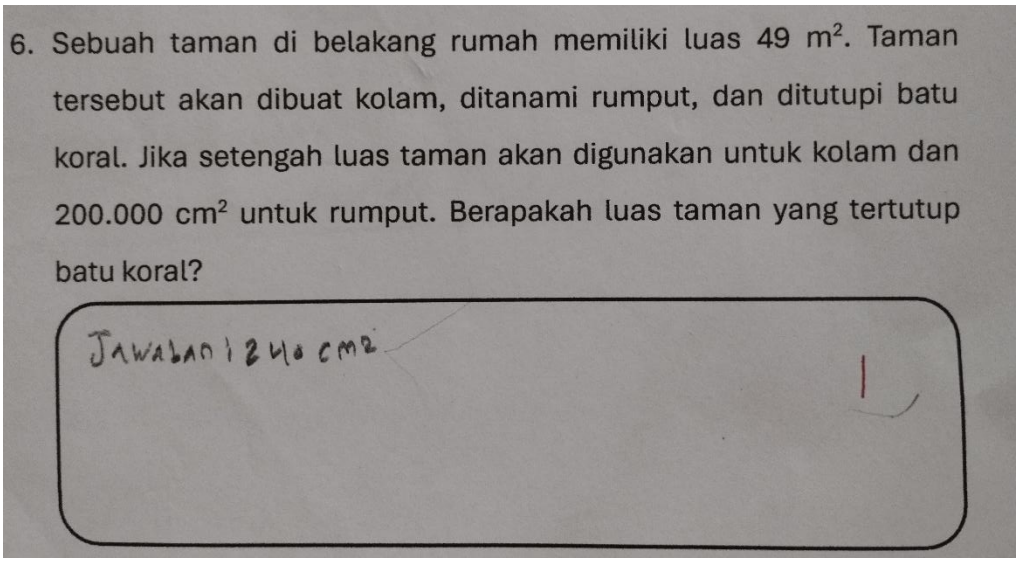

Figure 6. Students' Answers on Problem Number 6

The variable mathematical concept understanding ability on the indicator of applying concepts to problem solving is also applied to the last problem. Problem number 6 was made with the problem indicator, namely solving problems related to area. This problem asks students to determine the area of a garden covered with coral if it is known that the garden will be made into a pond and planted with grass. The first step that students can do is to change the unit of the garden area from m^2 to cm^2 or vice versa, the goal is to equalize the unit of area so that the problem can be found. After both units of area are the same, then students can calculate

the area of the garden covered with coral by subtracting the area of the garden from the area of the garden made into a pond and planted with grass. However, although the unit is correct, namely cm^2 as the unit of area, the answer of 240 cm^2 is wrong. Moreover, students did not provide a way to solve the problem from which the answer was found. These errors are in accordance with the opinion of Widodo et al. (2024) that there are two types of student errors in solving story problems, among others: (1) concept errors are student errors in determining, using, and writing formulas, (2) procedural errors are students wrong in the rules of working on problems. Sipa and Sari (2021) added that students usually face difficulties in working on math problems if the problems are in the form of story problems, causing errors when solving problems. After conducting interviews, it was found that students find it difficult to work on math problems in the form of stories. They added that the majority of students prefer to be given simple problems that immediately present commands to find answers.

CONCLUSION

Based on research conducted on 20 fourth grade students in one of the elementary schools in Tanjungsiang District, Subang Regency in the 2024/2025 academic year, it is concluded that the ability to understand mathematical concepts of students is in the low category. Of all the indicators of the ability to understand mathematical concepts tested on students, 35% of students are able to restate concepts that have been learned, 60% of students are able to classify objects based on whether or not the prerequisites are met to form the concept, 26% of students are able to apply concepts algorithmically, and only 25% of students are able to apply concepts to problem solving.

Based on the analysis of answers and interviews, it can be seen that the factors causing the low ability to understand mathematical concepts of students include: (1) weak instrumental understanding of students, (2) lack of understanding of the problem and not careful in working on the problem, (3) misconceptions in the formulas of area and perimeter of flat shapes, and (4) students are not used to working on non-routine problems.

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