

Analysis Of Students' Understanding Of Mathematical Concepts In Solving Questionsopen Ended On Percent Materials Students'

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Abstract. One of the abilities that must be possessed in mastering mathematics is mastery of mathematical concepts. To improve understanding of the mathematical concepts of percent material, a lot of effort is needed, including through problem solvingopen ended. Questionopen ended open-ended ones require comprehensive mastery of the material in solving the problem. The method used in this research is descriptive qualitative which describes the process of describing a situation observed in the field. Grade 5 students of SDN Sirahcai Sumedang Regency are the subjects of this research. A total of 20 students were given practice questionsopen ended regarding percent material. The data obtained comes from test results and interviews. The research results for each indicator are as follows: a) Restating the concept 80%, b) Classifying the objects that form the concept 35%, c) Identifying the nature of the concept 65%, d) Applying the concept logically 70%, e) Providing examples or non-examples concept 60%, f) Presenting concepts in various forms of representation 30%, (g) Linking various concepts, 60%, (h) Developing necessary or sufficient conditions 50%. From these results, errors were found that lie in errors in understanding the idea of the questions, inability to retrieve information from the question data, errors in understanding logic in conclusions, and errors in solution strategies.

Keywords: Ability of Understanding Mathematical Concepts, Open Ended, Percents.

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INTRODUCTION

One of the abilities that must be possessed in mastering mathematics subjects is mastery of mathematical concepts. The ability to understand concepts is a requirement that every student must have and is a requirement for understanding mathematics as a whole. This is because the ability to understand concepts can be a benchmark for the extent of a person's mastery of the depth of teaching material (Jabnabillah, 2022). Understanding concepts is also related to representing material in various forms of presentation. Comprehensive understanding of mathematical ideas is a real form of understanding a concept. Apart from that, understanding mathematical concepts includes mastery in providing illustrations and examples and expressing them again in accordance with the understanding concepts that have been received. Understanding in learning mathematics should be instilled in every student by teachers who act as educators (Wuryanti & Sutarna, 2022). Because, without understanding, students cannot apply procedures, concepts or processes. Learning mathematics does not start from memorizing countless formulas. The essence of learning mathematics is understanding the concept.

According to NCTM (2000) learning mathematics with understanding is very important. This becomes an indicator of a person's skill in mastering mathematical material so that they are able to re-apply what they have learned in learning into real life. One of the most robust findings of research is that conceptual understanding is an important component of proficiency, along with factual knowledge and procedural facility (Mayasari & Habeahan, 2021). Students who only memorize concepts without understanding will feel confused about when to use the concepts learned and this will result in less meaningful learning. Apart from that, this will result in mastery of concepts that will not last long in students' memories. Students who learn without understanding will have difficulty connecting the material they already have with the new material they receive. Based on this, students need to master understanding mathematical concepts because they can influence other abilities.

According to Sadirman in Azzahra (2019) stated that, "The emphasis in each lesson is on mastering concepts so that students have good basic provisions to achieve other basic abilities such as reasoning, communication, connections and problem solving." Concepts in mathematics are interrelated so that if students are unable to master one concept, they are likely to experience difficulties in the next concept.

However, from several previous studies it is known that students' understanding of mathematical concepts is not optimal. This is illustrated in previous research conducted by Unaenah & Sumantri (2019) which stated that, "Based on observations, it was found that 10 out of 20 students still answered questions about understanding concepts in fractions incorrectly. This happens because students lack understanding of mathematical concepts. One reason is because students do not yet have the prerequisite concepts for working on fraction material. "The prerequisite concepts include understanding the concepts of addition, subtraction, multiplication, division and the concepts of FPB and KPK." Thus, the concept of understanding prerequisite material becomes important in understanding the concept of teaching material (Fadzillah & Wibowo, 2016).

Ratnasari & Setiawan in Aulia & Kartini (2021) state that, "Learning difficulties in mathematics have their own characteristics when compared with learning difficulties in other subjects, including difficulty distinguishing numbers, mathematical symbols and not being able to remember propositions. -mathematical postulates". Learning difficulties which are considered slightly different are the cause of students' lack of understanding of mathematical concepts (Siregar, 2019).

Other research also shows several facts that students' understanding of mathematical concepts is still not optimal. As stated by Shofiah et al. (2021) in their research, "There are problems understanding the mathematical concepts of fifth grade students at SDN 1 Sidomulyo, Blora in the volume of blocks and volume of cubes when learning online via the WhatsApp application". Thus, a learning design is needed which can improve students' understanding of mathematical concepts in order to achieve optimal results. Damayanti & Mayangsari (2017) in their research also stated "Based on the results of observations carried out in class V of SD 2 Bae, it was stated that in general in this school learning uses lecture and teaching methods. independent assignments, but this method cannot overcome the problem of students' conceptual understanding. Although various methods have been carried out to improve students' conceptual understanding, such as holding remedial measures for students whose grades do not reach the standard of completeness and giving material development assignments in the form of questions. However, this has not been able to overcome the problem. students' understanding of concepts". Thus, a learning method is needed that is able to maximize students' understanding of mathematical concepts.

To find out the extent of students' understanding of mathematical concepts regarding a material, including through solving problems. Question Open Ended chosen because of several advantages. Excess open ended open-ended ones can provide opportunities for students to come up with varied answers to the various mathematical problems they are faced with. This means that children will get used to and really understand the concepts of the material being taught because this approach presents concepts according to students' way of thinking. Through solving problems open ended, students are not directed only to remember how to solve problems, but students are required to understand the concepts involved in solving them.

Several studies related to how Open Ended as a measure of concept understanding can be drawn from several previous studies. Setiawan & Harta, (2014) in their research revealed that, "Further test results show that: (a) the approach open-ended more effective than the contextual approach in aspects of students' mathematical problem solving abilities, (b) approach open-ended is no more effective than a contextual approach in aspects of students' attitudes towards mathematics". In other words open ended can help students solve problems, while indications that students can solve and solve mathematical problems show maximum understanding of the concept in students.

Another research by Ulfa & Lutvi, (2019) also states, "Achievement of MTs students' ability to understand mathematical concepts through the Open-ended approach and there is an increase

in MTs students' ability to understand mathematical concepts through the approach Open-ended". Based on the results of data processing, the average gain value was obtained, which can be interpreted as an increase in the ability to understand mathematical concepts by learning using the approach Open Ended. Thus open ended very influential in determining the extent of student mastery of a concept.

Next, researchers will conduct qualitative descriptive research by analyzing problem solving open ended carried out by students in order to determine the extent to which students have mastered understanding of mathematical concepts in percent material. Researchers will conduct research related to the analysis of student errors in answering questions open ended on percent material. Researchers want to know what errors students encounter in solving questions open ended on percent material. From there you can find out the indicators that are considered difficult in understanding the concept of percent material.

The aim of this research is to analyze the percentage of students' understanding of mathematical concepts in solving open ended questions on percent material, students' mistakes in solving them by referring to indicators of concept understanding.

METHOD

The method used in this research is a qualitative descriptive method. Qualitative descriptive research is scientific research that aims to find out and explain what the research subjects experience. In this research, researchers will attempt to explain and describe various forms of errors in solving problems open ended as well as the causes of student errors in answering questions open ended on percent material.

The subjects of this research were fifth grade students at Sirahcai State Elementary School, Sumedang Regency, for the reason that the abilities of this class were homogeneous. The number of subjects studied was 20 students. The scope of this research is limited to students' understanding of mathematical concepts in percent material. This research was carried out in the odd semester of the 2023/2024 academic year. The time for carrying out this research is Monday, September 11 2023.

The tests carried out are in the form of open ended questions in the form of story questions and interviews. The test is in the form of story questions given with various open alternative answers based on indicators of mastery of mathematical concepts including a) Restating the concept, b) Classifying objects based on whether or not the requirements that form the concept are met, c) Identifying the nature of the operation or concept, d) Applying concepts logically, e) Providing examples or non-examples of concepts, f) Presenting concepts in various forms of representation, (g) Linking various mathematical concepts, (h) Developing necessary or sufficient conditions.

After that, interviews were conducted to categorize the types of errors made by students after the test result data was processed. Three students with high scores, medium scores and low scores were selected and then analyzed to find out the factors that caused errors in answering the questions open ended on percent material. The interviews used were unstructured, meaning the questions were conditioned on the types of errors made by each student interviewed. The amount of ability to understand mathematical concepts in solving problems is calculated using a percentage formula (Sudijono, 1996), with reference to students' ability to understand concepts (Arikunto, 2013).

RESULTS

After carrying out an open ended test on percent material which was carried out on class V students of Sirahcai Elementary School, Sumedang Regency, the following results were obtained:

Table 1. Table of Students' Concept Understanding Gain through Questions Open Ended Percent Material

Indicator	Percentage	Category
estate the concept	80%	Good
Classifying concept-forming objects	35%	Less
Identify the nature of the concept	65%	Good
Apply concepts logically	70%	Good
Provide examples or non-examples of concepts	60%	Good
Presenting concepts in various forms of representation. Relating various concepts	30%	Less
Develop necessary conditions or sufficient conditions	60%	Good
	50%	Less

Table 2. Table Map of Distribution of Concept Understanding Indicators in Questions Open Ended Percent

Concept Understanding Indicator	Question Open Ended Percent
Restate the concept	Students are able to carry out procedural steps in finding the answer to 10% of Rp. 50,000,-
Classifying concept-forming objects	Students are able to procedurally find important objects which are important elements in solving the percent concept
Identify the nature of the concept	Students are able to take the elements needed to solve open ended questions as a whole
Apply concepts logically	Students are able to apply logical conditions in finding varied answers.
Provide examples or non-examples of concepts	Students procedurally answer correctly which items have the original price and which items need to be calculated first.
Presenting concepts in various forms of representation	Students are able to understand the concept of percent in representing shopping brochures with various provisions.
Linking various concepts	Students are able to solve questions by giving various answers to the questions <i>Open Ended</i> which is presented.
Develop necessary conditions or sufficient conditions	Students are able to take in any supporting information contained in the questions <i>Open Ended</i> percent.

According to Widodo in Wuryanti and Utama, (2022) stated that, "Students can be categorized as making conceptual errors if they show several characteristics. These characteristics are: students are unable to understand formula symbols and their places, experience errors in calculating, other people cannot read their writing, are unable to answer at all, and make mistakes when interpreting answers." These common errors are found in students' answers. However, in the answers to open ended questions, the percentage of errors related to understanding concepts looks more specific.

The form of questions given are questions with an open ended approach which are presented in the form of info graphics in a shop brochure. The brochure contains various basic provisions of the percent concept. The form of the question is as follows:



Figure 1. Brochure Image of Open Ended Questions on Percent Material

In the first indicator, namely restating the concept, the average percentage gain is 80% and is included in the good category. This proves that the majority of students are able to correctly answer the percent concept in the question. Students are able to answer correctly the value of 10% of Rp. 50,000,- and prove the acquisition through a coherent settlement procedure. Even though it is in the good category because it exceeds 50%, there are still some students who make mistakes in answering and there are students who only include answers without a solution. From the study of the interview results, information was obtained that students who only included their answers were because they got the answers from their friends' help, while some students who were unable to answer revealed that they had difficulty starting the proof in solving the percent concept in the questions. The discovery of students who do not have the initiative to answer themselves and wait for a friend's answer is nothing new, in research Abrar et al., (2020) also stated, "Some students just answer questions without knowing the flow of the solution or the initial concept that is used as a bright spot for solving the problem which are given." "What's more, when students are given practice questions, many students don't think enough about doing the practice questions and prefer to wait for answers from friends who have more abilities."

In the second indicator, namely classifying concept-forming objects, the average percentage gain is 35% and is in the poor category. This means that almost 65% of students have not been able to procedurally find important objects in the problem so they have difficulty solving the percent concept. Several students who answered incorrectly, in the interview session, stated that they were confused about what information was needed to find out the value of 50% of Rp. 50,0000, this results in difficulty in continuing to the next stage of completion. According to Pradini (2019) in his research stated that, "Students' limited reading comprehension skills cause students to be unable to identify the information they know and ask about relevant story questions correctly." Inability to retrieve important information in a question results in errors in correct answers (Halawa & Oktaviani, 2021).

In the third indicator, namely identifying the nature of the concept, the average percentage score is 65% and is included in the good category. This proves that the majority of students are able to take the elements needed to solve open ended questions as a whole so that the right answer is found. Even though it is in the good category because more than 50% of students were able to answer, there were 35% who were not able to meet this indicator. From the results of the interviews it was discovered that they had difficulty in linking one concept to another in the questions *open ended* provided so they don't get the right answer. Apart from that, students' inability to achieve this indicator is because students have misread the questions. According to this, it includes students' inability to write symbols, notations or numbers that are known in the problem. Amalia et al. in Jabnabillah (2022) states that, "Mistakes in reading questions can be seen from students who do not write down the meaning of the questions asked and cannot explain in writing."

In the fourth indicator, namely applying concepts logically, the average percentage score is 70% and is included in the good category. This proves that the majority of students are able to answer correctly and are able to apply logical requirements in finding varied answers to questions *open ended* provided. Most students were able to provide a variety of open answers, however there were still 30% of students who did not meet this indicator. According to Sri Hartatik (in Seran et al., 2022) states that, "The higher the ability to understand concepts possessed by students, the higher the ability to understand, solve and interpret the solution to a problem." Based on this, it can be concluded that the more solutions given to solve a mathematical problem, the more it is in line with the level of understanding of the concept. Through the results of interviews, it was discovered that several students experienced difficulties in determining the solution steps and made technical errors in calculations which resulted in wrong answers.

The questions presented are story questions, errors are often encountered in interpreting the questions. According to Zahra (2019), "Mistakes made by students are not being able to organize the meaning of the words they are thinking about into mathematical sentences, not being careful, forgetting, not having enough practice working on story questions in a variety of ways, not understanding the questions. It is possible that this type of question requires a deeper understanding.

In the fifth indicator, namely providing an example or not an example of a concept, the average percentage of results obtained is 60% and is included in the good category. This proves that most students are able to answer correctly which items have the original price and which items need to be calculated first. Even though it is in the good category because more than 50% of students were able to answer, there were still 40% of students who were not correct. Through interviews it was found that those who had wrong answers were due to an inability to determine the original price after discounts. According to Magdalena (2020) "Mistakes in understanding the problem are mistakes made by students after the students are able to read the problem in the problem but do not know the problem in the problem and do not know what problem they have to solve." In this case, some students do not know the problem asked in the question.

In the sixth indicator, namely presenting concepts in various forms of representation, the average percentage gain is 30% and is included in the poor category. This proves that most students are not able to understand the concept of percent in the form of shopping brochures which are presented with various provisions. Most students have not been able to interpret the information provided by brochure images and present it in the form of procedural steps for solving problems. There are 70% of students who have not been able to meet this indicator. Based on the interview results, it was discovered that students had difficulty writing the entire conclusion of the brochure's contents into mathematical sentences, so they did not get pariative answers to questions even though the open-ended nature of the questions provided open opportunities for answers.

In the seventh indicator, namely linking various concepts, the average percentage of scores is 60% and is included in the good category because more than 50% of students are able to fulfill this indicator. This can be seen from the answers of the majority of students who are able to relate various concepts so that they are able to solve questions by giving various answers to the questions *Open Ended* which is presented. Combining the concepts of multiplication, addition, subtraction and the concept of percent produces varied answers, although they are still limited. In this study, although it was stated in the good category, there were 40% of students who did not meet the indicators of linking concepts. According Izzati et al., (2021) that "The difficulty in understanding mathematical concepts in statistics material is students' inability to determine quartiles, inability to relate external mathematical concepts, namely algebra and comparison, and inability to understand story problems.". In line with this, difficulty linking various concepts in solving a mathematical problem is a common mistake. Those who had difficulty in the interview session expressed various reasons ranging from errors in using mathematical statements, errors in writing or errors in proof steps.

In the eighth indicator, namely developing necessary or sufficient conditions, the average score is 50% and is included in the insufficient category. This is because no more than 50% of students are able to fulfill this indicator, as can be seen from the answers of students who have

not been able to take all the supporting information contained in the problem into a mathematical statement so they are unable to fulfill the completion requirements. This causes students to be unable to collect the requirements and carry out the next stages, namely proving and drawing conclusions about answers. According to Mayasari & Habeahan (2021) stated that, "Students' low ability to understand concepts is caused by students' inability to understand concepts and use concepts that are appropriate to the problem." The result of the inability to develop necessary or sufficient prerequisites for a concept results in a lack of students' ability to apply and use the appropriate concept. In drawing conclusions, a solution to the problem in this indicator seems to be still lacking. This is also in line with what was conveyed by Damayanti, (2017) in her research who mentioned indicators of errors in drawing conclusions that, "Indicators of errors in drawing conclusions are: (a) Making conclusions without correct supporting reasons; (b) Concluding statements that are not in accordance with logical reasoning."

DISCUSSION

Based on the results above, it is known that for each indicator the following percentages are obtained: a) Restating the concept 80%, b) Classifying the objects forming the concept 35%, c) Identifying the nature of the concept 65%, d) Applying the concept logically 70%, e) Providing examples or non-examples of concepts 60%, f) Presenting concepts in various forms of representation 30%, (g) Linking various concepts, 60%, (h) Developing necessary or sufficient conditions 50%. From these results, errors were found that lie in errors in understanding the idea of the questions, inability to retrieve information from the question data, errors in understanding logic in conclusions, and errors in solution strategies.

In the first indicator, namely restating the concept, the average percentage gain is 80% and is included in the good category. From the study of the interview results, information was obtained that students who only included their answers were because they got the answers from their friends' help, while some students who were unable to answer revealed that they had difficulty starting the proof in solving the percent concept in the questions.

In the second indicator, namely classifying concept-forming objects, the average percentage gain is 35% and is in the poor category. Several students who answered incorrectly, in the interview session, stated that they were confused about what information was needed to find out the value of 50% of Rp. 50,0000, this results in difficulty in continuing to the next stage of completion.

In the third indicator, namely identifying the nature of the concept, the average percentage score is 65% and is included in the good category. From the results of the interviews, it was discovered that they had difficulty relating concepts to each other in the open ended questions provided so they did not get the right answers. Apart from that, students' inability to achieve this indicator is because students have misread the questions. In the fourth indicator, namely applying concepts logically, the average percentage score is 70% and is included in the good category. This proves that the majority of students are able to answer correctly and are able to apply logical requirements in finding varied answers to the open ended questions provided. Based on this, it can be concluded that the more solutions given to solve a mathematical problem, the more it is in line with the level of understanding of the concept.

In the fifth indicator, namely providing an example or not an example of a concept, the average percentage of results obtained is 60% and is included in the good category. This proves that most students are able to answer correctly which items have the original price and which items need to be calculated first. Through interviews it was found that those who had wrong answers were due to an inability to determine the original price after discounts. In the sixth indicator, namely presenting concepts in various forms of representation, the average percentage gain is 30% and is included in the poor category. This proves that most students are not able to understand the concept of percent in the form of shopping brochures which are presented with various provisions.

In the seventh indicator, namely linking various concepts, the average percentage of scores is 60% and is included in the good category because more than 50% of students are able to fulfill this indicator. This can be seen from the answers of the majority of students who are able to relate

various concepts so that they are able to solve questions by giving varied answers to the Open Ended questions presented. Combining the concepts of multiplication, addition, subtraction and the concept of percent produces varied answers, although they are still limited. In the eighth indicator, namely developing necessary or sufficient conditions, the average score is 50% and is included in the insufficient category. This is because no more than 50% of students are able to fulfill this indicator, as can be seen from the answers of students who have not been able to take all the supporting information contained in the question into a mathematical statement so they are unable to fulfill the completion requirements.

CONCLUSION

Based on data analysis, research results and discussion in the previous chapter, the research conclusion was that the percentage understanding of mathematical concepts in each indicator is as follows: a) Restating concepts 80%, b) Classifying objects that form concepts 35%, c) Identifying the nature of concepts 65%, d) Applying concepts logically 70%, e) Providing examples or not examples of concepts 60%, f) Presenting concepts in various forms of representation 30%, (g) Linking various concepts, 60%, (h) Developing necessary or sufficient conditions 50%.

Students' mistakes in solving open ended questions on percent material include the inability to retrieve information about the question data, errors in understanding logic in conclusions, and errors in solving strategies. Apart from that, there are errors. There are also technical errors such as errors in writing. Errors that are procedural in nature where students cannot give coherent answers and only write answers without proof. Students also sometimes have difficulty translating the brochure graphic info contained in the questions into mathematical sentences. Students also have difficulty relating several concepts to the questions, resulting in an inability to solve the questions completely.

Based on the conclusions of this research, the researcher wants to provide suggestions for teachers to be able to understand the characteristics and learning abilities of different students in understanding mathematics problems, especially percent. Then, in the learning process, teachers should give open ended questions more often because it can train students to understand mathematical concepts better. Suggestions for students are that every student should be able to understand the concepts in solving mathematics problems so that their learning outcomes can improve well. Solve mathematical problems in an open-ended manner and try to relate the problem solving to the mathematical material that has been given. The final suggestion that the researcher would like to convey is that it is hoped that this research can become a reference for future researchers so that they are able to contribute to efforts to improve the quality and quality of education.

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