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Analysis of the Mathematical Comprehension Ability of Grade VIII Students on the Pythagorean Theorem

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ABSTRACT

This study aims to describe students' mathematical understanding abilities, especially in circle material. This research was conducted at MTs Nurul Yaqin Pekanbaru to 10 grade VIII students. The method used in this study is a descriptive method using a qualitative approach to analyze student answers from the given instrument. The instrument used in this study was a written test of mathematical comprehension ability with two questions. Based on the results of data analysis, it can be seen that the mathematical understanding ability of class VIII students at MTs Nurul Yaqin Pekanbaru is still relatively low. Students cannot apply formulas in simple calculations, perform algorithmic calculations, and do not understand the questions given. During learning, only a few students actively asked and answered questions given by the teacher. Students who were less active in the learning process tended to listen and take notes delivered by the teacher. Students had difficulty understanding questions, were not challenged to solve non-routine math problems, were nervous about answering questions about poorly understood mathematic material, were doubtful about being able to learn difficult mathematic material on their own, and were unable to find new ways to do difficult math problems.

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INTRODUCTION

Education is one tool to improve the standard of living of the nation. Education is an effort to improve the quality of human resources (HR). Education can be taken one of them at school, from several subjects studied by students, mathematics is one of the most important sciences in the world of education.

One important factor in learning mathematics today is developing students' mathematical understanding abilities. The ability to understand mathematics is one of the visions of mathematics and national education goals [1]. The current conditions in the field generally do not involve students' activities in learning mathematics [2]. Then Wahyudin in [2] also stated that most students seemed to follow every explanation or information from the teacher. Students rarely asked questions, so the teacher was engrossed in explaining what he had conveyed.

Even Wahyudin in [2] emphasized that mathematics teachers generally teach using the expository lecture method. This shows that students are less active in learning. Hence, students' mathematical understanding of the lesson is very difficult, and not even many students do not understand the lessons given and explained by the teacher. One attempt to

Analysis of Mathematical Understanding [2] Developing creativity in learning mathematics is by integrating a model for developing creativity in teaching and learning mathematics. According to [3], understanding is a fundamental aspect of learning, so the learning model must include the main

points of understanding. The main things to understand about an object are the object itself, its relationship with similar objects, and its relations with other objects that are not similar.

Based on the results of the initial observations of researchers at MTs Nurul Yaqin Pekanbaru in February 2021, some material is used as a reference for four levels of mathematical understanding ability. The results of interviews with class teachers show that students understanding of the Pythagorean theorem material is still low. So the researchers researched students' mathematical understanding of the subject matter of the Pythagorean theorem. Quality learning is necessary to teach students so they can develop their understanding abilities. In addition, it must also pay attention to the suitability of the level of student development with the learning model used so that maximum output is obtained. Understanding is a level 2 cognitive aspect after knowing the level based on Bloom's Taxonomy [4]. So understanding is an important part of a student's cognitive development.

According to [5], mathematical understanding is students' knowledge of concepts, principles, and procedures and students' abilities to use solving strategies for a problem presented. While [6] says that comprehension is a person's ability to understand or understand something after something is known and remembered. In other words, understanding is understanding something and seeing it from various angles.

In learning mathematics, mathematical understanding is an important factor in understanding the material being taught to students, because this is not just memorizing theory, but rather an understanding of the subject matter being taught.

Based on the PISA International survey results, the mathematical abilities of junior high school students in Indonesia are in the lower ranks [7]. This could be due to the poor learning patterns in Indonesia compared to other countries, such as Finland. In addition, the average public interest in reading, especially students, is also low, which is also the cause of the weak ability to understand mathematics in Indonesian society in general.

The mathematical understanding that will be used in research is instrumental understanding and relational understanding. Both types of understanding are interpreted as follows. Instrumental understanding directs students to understand simple mathematical concepts and theories. Students are usually faced with the problem of difficulty understanding the concept of a theory. Understanding the relational type directs students to understand the structure of concepts and relate them to solving broader problems.

Skemp [8] classifies understanding into two stages: a. Instrumental understanding, namely memorizing concepts/principles without any other connection by applying simple calculation formulas. b. Relational understanding, namely associating one concept/principle with other concepts/principles. Because of the importance of these two types of understanding, research on mathematical understanding is limited to instrumental and relational abilities. Reports of student learning outcomes are a summary of student assessments that have carried out the learning process within a certain time. In this case, the researcher will analyze students' mathematical understanding regarding student learning outcomes reports. By conducting this research, it is hoped that data on low, medium, and high-level student understanding of the questions presented at UAS will be obtained.

According to [9], the term understanding comes from the word understand, which according to the Big Indonesian Dictionary, is defined as a lot of knowledge, opinion, flow, and true understanding. Understanding is a process, method, deed, understanding, or comprehension. In learning, understanding is meant as students' ability to understand what has been taught by the

teacher. In other words, understanding is the result of the learning process. Thus it can be understood that understanding is a mental process of adaptation and transformation of knowledge.

According to [10], Understanding is understanding an object or subject of learning. The ability to understand is possible when some knowledge precedes it. Therefore understanding is at a higher level than knowledge. Understanding is not just remembering facts but the ability to explain, explain, interpret, or grasp the meaning or meaning of a concept. The ability to translate, namely the ability to explain the meaning of symbols into other sentences with the same meaning. Understanding interprets something, such as graphs, charts, or pictures. While understanding extrapolation, namely the ability to see behind what is implied or stated or the ability to continue or predict something based on an existing pattern.

Learning that leads to efforts to provide understanding to students is learning that directs students to understand what they learn and know when, where, and how to use it. Comprehension differs from memorization, a learning process that only provides knowledge in the form of theories and then stores them piled up in their memory. This learning model is ineffective learning. This is because the learning process does not give meaning to students. Learning effectiveness is determined by whether there is a process of understanding or understanding knowledge. And the dominant mental process in understanding is thinking [9].

A person is said to understand something if he has been able to organize and restate what he has learned using his own words. Students no longer remember and memorize information obtained but must be able to select and organize that information. This is in accordance with what Sanjaya wrote that understanding is not just remembering facts but regarding the ability to explain, explain, interpret, or grasp the meaning or meaning of a concept [11].

According to [7], six characteristics of learning contain the understanding, namely:

1. Understanding is influenced by basic abilities
2. Understanding is influenced by past learning experiences
3. Understanding depends on the setting of the situation
4. Understanding is preceded by trial and error
5. Learning with repeatable understanding
6. An understanding can be applied to understanding other situations.

Michener stated that understanding is one aspect of Bloom's taxonomy. Understanding is the absorption of the meaning of a material being studied. To understand an object in depth, one must know 1) the object itself; 2) its relation with other similar objects; 3) its relationship with other objects that are not of the same kind; 4) dual relations with other similar objects; 5) relations with objects in other theories.

Understanding (Understanding) is the ability to explain the situation with different words and interpret or draw conclusions from tables, data, graphs, and so on. Understanding is more important than just memorizing. Therefore, it is not wrong to give directions or guidance to students. They are not asked to memorize, but understanding is far more important. Bloom clarifies understanding into the second cognitive level, which describes an understanding so that a person knows how to communicate and express his ideas for communicating. Understanding is not just understanding information but also includes objectivity, attitude, and meaning contained in the information. In other words, a person can change the information in his mind into another, more meaningful form.

According to [12], Understanding is a standard set of educational programs that reflect competence to lead students to become competent in various sciences. Understanding (comprehension) can be interpreted as mastering something with the mind.

So understanding is the ability to explain situations in their own words and interpret or draw conclusions from tables, data, graphs, etc. To understand something, according to Bloom, students must carry out the following five stages, namely: 1) receiving; 2) responding (comparing); 3) valuing (assessing); 4) organizing (arranged); 5) characterization (setting values). Understanding will grow and develop if there is a clear and systematic thinking process. So that a teacher should not complicate the easy ones, but on the contrary, should simplify the difficult ones. Judging from its type, according to Russefendi, there are three kinds of mathematical understanding, namely: translation, interpretation, and extrapolation. Understanding translation conveys information in other languages and forms and gives meaning to various details. The ability to see the relationship between concepts is related to the ability to think analytically. To think analytically, you need a high understanding. As stated in Bloom's taxonomy of objectives, that understanding is a fundamental aspect and a prerequisite for moving to the next level, namely application, analysis, synthesis, and evaluation. Applying this mathematical understanding is important for students to learn mathematics meaningfully. Of course, the teachers expect that the understanding achieved by students is not limited to instrumental understanding but up to relational understanding.

According to Ausabel, meaningful learning is when the information students will learn is arranged according to their cognitive structure. That is, students can associate new information with their cognitive structure. That is, students can associate the knowledge they have with other situations so that learning is more understandable

According to [1], The ability to understand mathematics is the ability to absorb and understand mathematical ideas. Indicators of mathematical understanding ability, namely:

1. Identify, exemplify, and non-example.
2. Translate and interpret the meaning of symbols, tables, diagrams, pictures, graphs, and mathematical sentences.
3. Understand and apply mathematical ideas.

The importance of ownership of understanding by students is also expressed by Santrock [1], that conceptual understanding is a key aspect of learning. As well as mathematical understanding is an important foundation for deep thought to solve problems mathematics and real-life problems. In addition, comprehension ability math is very supportive of the development of other mathematical abilities, namely communication, solving problems, reasoning, connection, representation, critical thinking, and creative thinking mathematics and mathematical abilities other. Wiharno [1] expressed a similar opinion that mathematical understanding ability is a necessary force noticed during the learning process of math, especially to acquire meaningful mathematical knowledge.

Qohar [13] states that the ability to understand mathematics is the ability to classify mathematical objects, interpret ideas or concepts, find examples of a concept, provide examples and non-examples, and restate mathematical concepts in their own language.

According to [14], There are several aspects of mathematical understanding abilities, namely:

1. Concept understanding

An ability related to understanding comprehensive and conventional mathematical ideas. Indicators of the ability to understand mathematical concepts, namely:

a. Restate the concept that has been learned

b. Classifying objects based on mathematical concepts
c. Applying the concept algorithmically
d. Give examples or counterexamples of the concepts being studied
e. Presenting concepts from various representations, and
f. Linking various mathematical concepts internally or externally.

2. Mechanical understanding

The ability to remember and apply notations, symbols, formulas/formulas in mathematics routinely or through simple calculations.

3. Rational understanding

The ability to prove the truth of a principle or theorem systematically.

4. Inductive understanding

The ability to try something in simple cases and make an analogy with similar cases.

5. Intuitive understanding

The ability to estimate something without a doubt before doing an analytical analysis.

6. Instrumental understanding

Ability to memorize and understand concepts or principles separately, apply formulas in simple calculations, and perform calculations algorithmically.

7. Relational understanding

The ability to correctly associate a concept/rule with other concepts/rules and be aware of the process.

Based on several studies, it has been suggested that the mathematical understanding abilities of junior high school students still need to be improved. Students still have difficulty understanding the material because of abstract mathematical concepts.

Based on the findings of [15] in students in one of the junior high schools, it was found that in one class of 35 students, only five students were already at the formal (abstract) thinking stage, while 30 students were at the concrete operational thinking stage. So they have difficulty understanding mathematical concepts that are still abstract to them.

According to [16], it was found that junior high school students' mathematical understanding was still low. Similar to Putra's findings et al. (2018), in one of the junior high schools, as many as 41.67% of students still had comprehension skills at low criteria, 30.56% were at medium criteria, and 27.72% were at high criteria.

Based on the explanation about the ability to understand mathematics shows that it is an important ability to be developed in high school students. Then it can be concluded that mathematical understanding has indicators, including making examples and not examples, translating and interpreting the meaning of symbols, tables, diagrams, pictures, graphs, and mathematical sentences, and understanding and applying mathematical ideas.

So based on the description above, the formulation of the problem in this study is how the

mathematical understanding of students at MTs Nurul Yaqin Pekanbaru on the Pythagorean theorem material in terms of learning outcomes reports. Then this research was conducted to identify the mathematical understanding of MTs Nurul Yaqin Pekanbaru students on the Pythagorean theorem material regarding learning outcomes reports.

METHODS

This research is qualitative with the type of case study research conducted at MTs Nurul Yaqin Pekanbaru in the even semester of the 2020/2021 academic year in class VIII. The subjects of this study were class VIII students at MTs Nurul Yaqin Pekanbaru, totaling ten students. While the object of the trial in this study was an analysis of the mathematical understanding abilities of grade VIII junior high school students on the Pythagorean theorem material

The data collection technique used to obtain data in this study is a test. The test used in this study was a written test in the form of an essay test. The test is a number of questions related to the mathematical material to be studied. In this case, the writer will conduct tests on students as the selected subjects in this study.

After the test is carried out in essay questions, scoring will be carried out. Scoring is done based on the scoring rubric of mathematical understanding ability. The scoring of mathematical understanding skills is used in the rubric for assessing mathematical understanding abilities developed by Thompson [17].

Table 1. Mathematical Understanding Assessment Criteria

Score	Criteria
4	Complete understanding of concepts and principles of math problems; correct use of terms and notations; complete and correct use of the algorithm
3	Understanding the concepts and principles of almost complete math problems; the use of mathematical terms and notation is almost correct; complete use of the algorithm; The calculations are generally correct but contain a few errors.
2	Understanding the concepts and principles of math problems is very limited; answers mostly contain wrong calculations.
1	Given that students can understand the concepts and principles of very limited math problems.
0	Does not show understanding of concepts and principles of math problems.

The instrument used in this study was a descriptive test sheet, which is a test designed to analyze the mathematical understanding experienced by students in solving Pythagorean theorem material problems. Based on the test results, it can be seen that students solving Pythagorean theorem problems carried out the analysis of mathematical understanding.

RESULTS AND DISCUSSION

This research was conducted in one class VIII at one of the private MTs in Pekanbaru, namely MTs Nurul Yakin. In accordance with the research questions raised previously, to answer the research questions, a discussion and analysis of the answers are carried out to reveal the ability of students to understand mathematics from each answer to the test questions used as the research sample. Describe students' mathematical understanding in solving problems on the Pythagorean theorem material for

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each problem. The table below was developed based on the categories of students' mathematical understanding abilities in Table 1, and descriptions of students' comprehension scores in each question indicator are in Table 2.

Table 2. Categories of Students' Mathematical Understanding Ability

Category	Achievement of Mathematical Understanding Ability
High	> 70%
Moderate	55% ≥ 70%
Low	≤ 55 %

Table 3. Description of Students' Understanding Scores in Each Question Indicator

No	Name	Question Number	
		1	2
1	Cs1	2	0
2	Cs2	2	4
3	Cs3	2	4
4	Cs4	0	4
5	Cs5	2	4
6	Cs6	2	4
7	Cs7	0	0
8	Cs8	2	0
9	Cs9	0	0
10	Cs10	2	4
	Total	14	24
	Average	1,4	2,4
	Percentage	35%	60%

Table 3 shows that the highest percentage is in question number 2, with a percentage of 60% and a low percentage of 35%. If all questions are totaled and presented, they will get a value of 47.5%, and it is said that the student's understanding ability is low. The students' comprehension ability is low due to a number of things, including (1) they do not understand the questions given, (2) they do not understand the formulas, and (3) students are rarely given questions about their ability to understand mathematics. Then in the learning process still uses ordinary learning, the teacher dominates in learning. During the learning process, only a few students actively asked and answered questions given by the teacher. Students who were less active in the learning process tended to listen and take notes from the teacher. Learning only went in one direction. The following are student answers with low percentages:

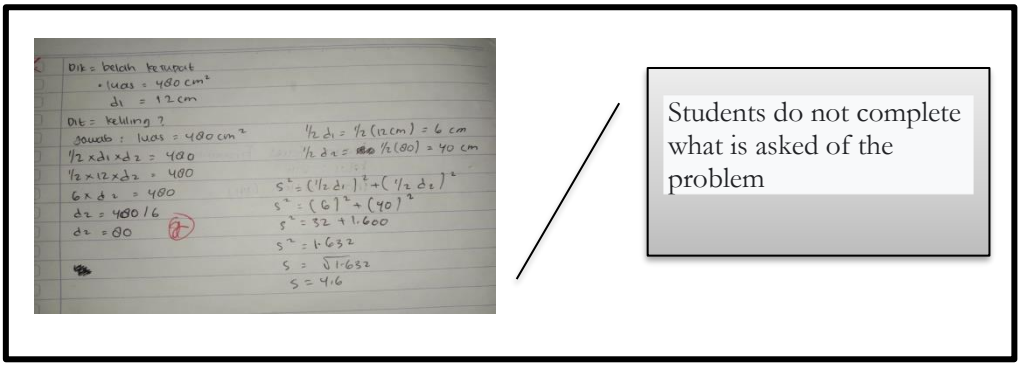

Figure 1. Answers From Students for Number 1

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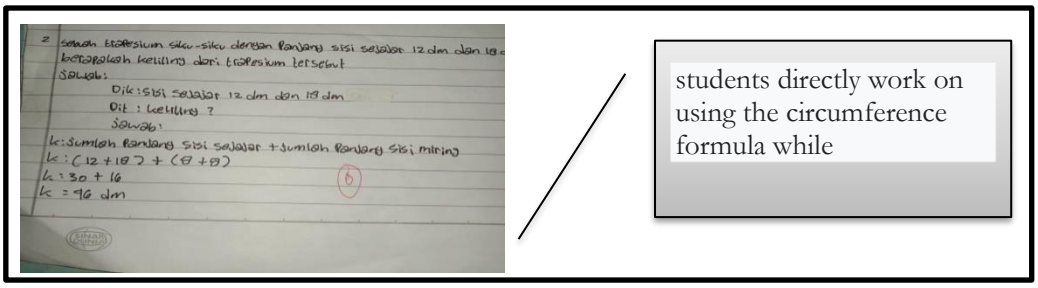

Figure 2. Answers From Students for Number 2

The students' answers above show that they still do not understand the questions well. An inaccurate interpretation causes the solution to be carried out to be also inaccurate. From all categories of students' mathematical understanding ability, that indicator of mathematical manipulation is still not appropriately fulfilled. Based on the test results, the achievement indicator of the ability to link various (internal and external) mathematical concepts and the ability to apply concepts algorithmically was only 35%. This can be seen in the results of the work done by several students. Only a few students could understand the intent of the questions given.

CONCLUSIONS AND SUGGESTIONS

Based on the results of research in class VIII MTs Nurul Yaqin Pekanbaru, an overview of students' mathematical understanding abilities on the Pythagorean theorem material can be low, with an average score of 2 description questions of 47.5. Students can correctly solve part of question number 1, but it's wrong in the core part of the question in question. This is because students do not understand the meaning of some of these questions due to misunderstanding and inaccuracy in working on these questions. To overcome the difficulties experienced by students, it is necessary to develop methods/strategies/learning models or teaching materials that can overcome some of the difficulties in triangular and quadrilateral material. Suggestions for further research development can analyze students' mathematical understanding abilities with different subject matter.

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