

ANALYSIS OF STUDENTS' ABILITY TO UNDERSTAND CONCEPTS IN SOLVING ALGEBRA MATERIAL PROBLEMS ACCORDING TO SKEMP THEORY

Vina Fitriani^{1*}, Nunu Nurhayati², Nuranita Adiasutty³

^{1,2,3}Mathematics Education Study Program, Faculty of Teacher Training and Education, Universitas Kuningan, Jl. Cut Nyak Dhien 36A, Kuningan, Indonesia

ABSTRACT

This study aims to describe how the ability of students' understanding of concepts in solving algebra material problems according to Schemp theory. This study uses qualitative descriptive method. The data collection technique used is a test of the ability to understand algebraic concepts as many as 3 questions, interviews and observations. The data were analyzed based on 3 indicators of understanding the concept according to the scheme, namely being able to know and explain the method of solving the problem being done, being able to connect the method with various concepts and being able to adapt the method to new problems. The results showed that: 1) students with high categories are able to know and explain the method of solving the work done, able to connect the method with a variety of concepts even though the answers obtained are not precise and able to adjust the method to new problems; 2) students with the medium category are able to know and explain the method of completion is done, able to connect the method with a variety of concepts but the answers obtained are not appropriate, but not able to adjust the method to new problems; 3) students with low categories are able to know and explain the method of completion is done even though the answer is not right, in addition, students with low categories have not been able to connect the method with various concepts and have not been able to adjust the method to new problems.

Keywords: algebra; concept understanding ability; scheme theory.

1. Introduction

Education is one of the important things for the survival of a human being because education is able to determine and lead a person towards a brighter future. Mathematics is one of the fields of study that exist at all levels of education, ranging from elementary school to college, therefore mathematics is a compulsory subject that must be studied. Where mathematical concepts are taught in a sequential and gradual manner at each level according to the mental and intellectual conditions of students. Mathematics needs to be taught to students because mathematics is always used in all aspects of life (Nugraha et al., 2015). Many things in real life require math skills Plus Math an improve logical thinking ability. Mathematics also plays an important role in shaping attitudes, developing students ' intellectual and logical abilities so that they are able to solve a problem that is both related

to mathematics and daily life (Widiyanti et al., 2014).

Learning mathematics is not just about formulas and numbers, but in the process of learning mathematics understanding mathematical concepts is also very important. Understanding concepts in mathematics provides a useful foundation in solving math problems in the classroom and in everyday life (Oktaviani & Haerudin, 2021). This is in line with the learning objectives set forth by Yati et al. (2014) that is so that students have the ability of mathematical concepts, the ability to communicate mathematical ideas, critical thinking skills, and problem solving skills. Therefore, students are required to understand mathematical concepts, especially basic concepts.

Concept understanding is a process to put an information or knowledge that is being learned then associated with other knowledge possessed by previous students (Carpenter & Hiebert, 1994). This is because mathematical concepts are related

to each other (Oktaviani & Haerudin, 2021). Each student certainly has different experiences and knowledge about mathematics, when students learn about a new concept they will naturally make connections to concepts they have known before then develop their own understanding in a way that makes sense to them (Prayitno, 2018).

One of the mathematical materials that require understanding of the most basic concepts is algebra, according to Yuliyani (2016) algebra is a very basic or fundamental material in the field of mathematics, besides in everyday life algebra has many benefits and applications. Algebra was first taught in junior high school (SMP). The introduction of important algebra concepts is given to students, because these concepts will be used and applied to various areas of mathematics that students learn (Kusumawati & Sutriyono, 2018). These algebraic concepts will be instilled or given effectively in school learning.

Algebra is one of the materials found starting from Junior High School and even to college. Everyone who has ever attended school must have used the concept of algebra either directly or indirectly. But there are still many students who have difficulty in learning algebra, one of which is the difficulty of algebraic operations. Several studies have shown that many 13-year-olds cannot perform addition and subtraction operations on algebraic forms (Linchevski & Herscovics, 1996). Students often remove symbols or variables when performing operations on algebraic forms, ignoring variables and focusing only on their addition and subtraction (Linchevski, 1995). Therefore, understanding the concept of algebra is important for students to master, especially the concept of algebra is used to facilitate the mastery of other material at the next level. One example is the sequence and Series material taught at the high school level (SMA) where the concept is interrelated with the concept of algebra. So understanding algebra concepts in junior high school is very important to note so as not to have a bad impact on the understanding of other concepts.

Junior High School students, especially Class VII, are still at the transition of cognitive age from elementary school, namely concrete thinking towards semi-formal thinking. So that students are required to adjust the thinking stage. This transitional period certainly resulted in various difficulties for students, one of which was the understanding of algebraic concepts. Below is one

example of a student who made a mistake in understanding the concept of algebra in solving algebra problems.

$$\begin{aligned}
 \text{Panjang sisi} &= (x+12)m + (2x-2)m + (3x-3)m \\
 &= (x+12) + (2x-2) + (3x-3) \\
 &= 13x + 0 + 0 \\
 &= 13x
 \end{aligned}$$

Figure 1 Examples of Student Mistakes

The above example shows that students still make mistakes in operating algebraic forms. The student is wrong in calculating $(x + 12) + (2x - 2) + (3x - 3)$, where he operates all the elements without being grouped according to their respective types so that the result becomes wrong. The variable x should be grouped with the variable x , and the constant with the constant so that it can be operated on. This is one of the errors where students can not distinguish between variables and constants in algebraic form. In line with research conducted by Herawati & Kadarisma, (2021) that students experience misunderstandings in solving algebraic operations. Students have the assumption that a number contained in the same operation is simply operated on, even though it cannot be done considering that the two numbers have different variables which ultimately results in the wrong answer. This shows that students' ability to understand concepts in solving algebra problems is still lacking even to perform simple operations as in the example.

Based on the description above, the researchers want to analyze the ability of understanding the concept of Junior High School students in solving problems on algebra material according to The Theory of understanding Schemp on high-ability students, medium-ability students and low-ability students. The purpose of this study was to describe the ability of understanding the concept of Junior High School students in solving problems in algebra material. Then, this study is expected to provide benefits for students, for teachers and for researchers to be able to know the ability of understanding the concept of students.

2. Research Methods

The research method used in this study is descriptive qualitative research. This is because the data obtained in the form of qualitative descriptive data, namely in the form of written and

spoken words from people and observed behavior (Moleong, 2017). This study was conducted with the aim to describe the ability of students' understanding of mathematical concepts in solving problems in algebra material. The research to be conducted is qualitative descriptive research with case study design. This research focuses in depth on one object to be analyzed regarding the types of difficulties and their causes. In line with the opinion (Parenti, 2017) a case study is a series of scientific activities carried out intensively, in detail and in depth on an event, program and activity, whether on an individual, a group of people, an institution or an organization with the intention of obtaining in-depth knowledge about the event. The chosen event is usually an actual event (real life events) that is an ongoing event, not something that is already past. The case analyzed in this study is the lack of ability to understand the concept of students in solving problems in algebra material.

The study was conducted in Junior High School of 4 Kuningan with participants in Class VII A even semester 2021/2022. The population in this study is Class VII A students totaling 28 people, then will be selected some students to be the subject of research. With data collection techniques used, among others, there are 3 methods including tests, interviews and observations. The research subjects consisted of 6 students, namely 2 people with high Ability, 2 people with medium ability and 2 people with low ability who were classified based on the results of the algebra problem Test as many as 3 questions. The percentage of Score results that have been obtained will then be interpreted to determine the level of students' understanding of the concept of high, medium and low using the criteria table according to Ridwan & Akdon (2011) :

Table 1 Percentage of Ability to Understand The Concept

No	Percentage	Level Of Understanding
1	0% - 20%	Less once
2	21% - 40%	Less
3	41% - 60%	Enough
4	61% - 80%	Good
5	81% - 100%	Very Good

The subjects were then interviewed and observed to obtain more accurate data. Data analysis techniques in this study begins with reducing the data, the researchers analyzed the results of student work to determine the

understanding of the concept of students and then choose the subject of research as many as 6 students who are classified based on 3 indicators of understanding the concept of students. Then the subject is interviewed. At the stage of presenting the data the results of the work of students and transcripts of interviews are reduced and then presented in the form of diagrams, tables and descriptions. Furthermore, at the stage of drawing conclusions, the researcher concludes the data that has been presented that is adjusted to the formulation of the problem that has been made previously.

3. Results and Discussion

Based on the results of the analysis of students' concept comprehension skills, there are still many students who do not have high concept comprehension skills, as shown in Table 2 below:

Table 2 Students' Ability To Understand Concepts

Concept Comprehension Ability Category	Interval	Amount
High	$(65 \geq x \geq 100)$	4
Enough	$(41 \geq x \geq 60)$	10
Low	$(10 \geq x \geq 40)$	14
Total Students		28

The results of students' concept comprehension skills in solving algebra material problems in class VIIA, from 28 students who took the concept comprehension ability test had an average score of 40.47% and belonged to the level of understanding categorized as less. The obtained percentage of understanding of each indicator is as in Table 3:

Table 3 Percentage Of Students' Concept Understanding Of Each Indicator

Indicators Of Understanding The Concept	Percentage	Categories
Able to know and explain the method of settlement undertaken	65,48%	Good
Able to connect methods with various concepts	59,26%	Medium
Ability to adapt methods to new problems	29,63%	Less

List of research subjects consisting of 2 students with high Ability, 2 students with medium ability, and 2 students with low ability using coding as follows :

Table 4 Coding Of Research Subjects

Code	Description
S ₁ T	Student 1 with high concept understanding
S ₂ T	Student 2 with high concept understanding
S ₁ S	Student 1 with medium concept understanding
S ₂ S	Student 2 with medium concept understanding
S ₁ R	Student 1 with low concept understanding
S ₂ R	Student 2 with low concept understanding

Based on the problem number 1 on the indicator of understanding the concept of being able to know and explain the method of solving the problem, students with high concept understanding ability categories, namely S₁T and S₂T, both of them are able to know and explain the method of solving what they are doing is seen from the first step, make an algebraic form of the information on the problem and then operate it so as to get the ordered result on the problem. In line with research from Putra et al., (2018) that students are said to have a good understanding ability is when he can solve a problem correctly.

Students with medium concept comprehension ability categories, namely S₁S and S₂S. Based on the results of the work on the problem number 1 S₁S and S₂S is said to have been able to know the method of solving the work done but the answer is not right, S₁S wrong in modeling into algebraic form so that the next step becomes wrong while S₂S wrong in interpreting the information from the problem so that the next step has been ascertained wrong. This is caused by students who are less thorough in working on the problems, as said by Herawati & Kadarisma (2021) in his research that students are less thorough in calculations so that it affects the results of the answer..

Students with low concept comprehension ability categories are S₁R and S₂R. Based on the answer sheet of the concept comprehension ability test results, S₁R is said to be able to know the method of solving in the initial step, it can be seen

from how it simulates algebraic variables, it's just that for the next step it tends to be wrong. some of these errors, among others, is wrong in modeling the algebraic form of the problem, so that when the results obtained are substituted into the algebraic form it does not get the correct result. S₂R subjects are said to be able to know the method of solving at the initial step, but the results of the work done have many errors, namely errors in interpreting information from the problem into algebraic form and errors in performing calculations. In line with research conducted by Septipriyani & Novtiar (2021), that students arrange algebraic forms first to answer problems, but when doing calculations students make mistakes so that the final results obtained are wrong. When confirmed through interviews students with low category are not able to explain the answer well.

Based on the above statement, it can be concluded that students with high categories and have been able to know and explain the method of solving the work, only students with medium categories have not been able to get the right answer. While students with low categories have not been able to know and explain the method of completion is done.

Based on Problem Number 2 on the indicator of understanding the concept of being able to connect methods with various concepts, students with high concept understanding ability categories are S₁T and S₂T. S₁T has been able to connect algebraic methods with concepts related to the problem, but S₁T does not understand the concept of operation in the division of algebraic forms, the rest can be mastered well. While S₂T is only able to find the relationship between algebraic concepts with the concept of Square, but does not perform any operations. This is in line with the research Putra et al., (2018) that students know the meaning of the problem, but do not understand how the right way to solve it.

Students with medium concept understanding ability categories are S₁S and S₂S. Based on the answer sheet of the test results of the ability to understand the concepts of both subjects, both S₁S and S₂S, are able to connect algebraic concepts with other concepts in the problem, but the answer is not right because there is an error in operating the quadratic in algebraic variables. This is in line with the research of Wahyuni, Yusmin & Suratman in Sari & Afriansyah, (2020) who said that students were less able to generalize because they did not understand arithmetic operations, so they were unable to operate square numbers.

Students with low ability to understand the concept of S_1R and S_2R . Both are said to have not been able to connect algebraic methods with other concepts in the problem, judging from the answers of students who did not continue and did not perform any computational operations. This is in line with research from Herawati & Kadarisma, (2021) that students have not been able to solve the problem because students do not know what concepts are asked so that it affects the work on the problem. In addition, Farida (2015) also argues that students make mistakes in solving problems in the problem is because students do not pay attention to what is meant and asked in the problem.

So it can be concluded that students with high and medium concept comprehension ability categories are able to connect methods with various concepts but the answers obtained are not precise. While students with low concept comprehension ability category have not been able to connect the method with various concepts.

Based on Problem Number 3 on the indicator of being able to adjust the method to new problems, students with high concept understanding ability categories, namely S_1T and S_2T , both of them have been able to adjust algebraic methods to new concepts in the problem, the subject performs the correct calculations and gets the right results. In line with the opinion of Putra et al., (2018) that students are said to have a good understanding ability is when he can solve a problem correctly.

Students with medium concept comprehension ability categories, namely S_1S and S_2S , both are said to have not been able to adjust the concept of algebra to new problems in the problem. This is because the students misinterpret the instructions in the questions. This is in line with the research of Aini & Siswono (2014) that students can communicate what is contained in the problem, the problem asked and the steps in solving the problem. However, there is still a lot of wrong information received, resulting in errors.

Students with low concept comprehension ability categories, namely S_1R and S_2R . S_1R and S_2R can not perform the completion seen from the blank answer. After being confirmed through interviews and observations, S_1R and S_2R did not understand the meaning of the problem so they did not know how to solve the problem. In line with Herawati & Kadarisma (2021), students have not been able to understand what concepts are asked

and referred to in the questions, so that it affects the way of working that makes the answers empty.

So it can be concluded that students with high understanding categories are said to be able to adjust the method to new problems, while students with medium and low understanding categories have not been able to adjust algebraic concepts to new problems in the problem.

4. Conclusions

Based on the results of research and discussion, it can be concluded that the percentage of understanding of concepts for high ability students as much as 14.29%, medium ability students as much as 35.71% and medium ability students as much as 50% with an average score of understanding the concept of 28 students of 40.47% with less category.

Students with high categories are able to know and explain the method of solving the work done, able to connect the method with various concepts even though the answers obtained are not precise and able to adjust the method to new problems. Students with the medium category are able to know and explain the method of solving the work done, able to connect the method with various concepts but the answers obtained are not precise, but not able to adjust the method to new problems. Students with low categories are able to know and explain the method of solving the work done even though the answer is not right, in addition, students with low categories have not been able to connect the method with various concepts and have not been able to adapt the method to new problems.

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