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The Relationship Between Concept Understanding Ability And Problem-Solving Ability With Learning Outcomes In Algebraic Form

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Abstrak

Tujuan dari penelitian ini adalah untuk memastikan keberadaan dan signifikansi statistik dari korelasi potensial antara pemahaman konsep individu dan pencapaian mereka dalam memperoleh bentuk aljabar. 2) Kemahiran keterampilan pemecahan masalah dengan fokus pada pencapaian tujuan pembelajaran aljabar. 3) Kemahiran dalam memahami konsep-konsep abstrak dan menunjukkan keterampilan pemecahan masalah dalam konteks tujuan pendidikan aljabar. Penelitian ini menggunakan metodologi survei korelasional. Sampel penelitian terdiri dari 65 siswa kelas VII SMP N 1 Siau Timur Selatan. Pengumpulan data menggunakan pendekatan sampel jenuh, yaitu mencakup seluruh populasi siswa. Selama pelaksanaan penelitian, total siswa yang tidak hadir berjumlah 15 orang, sehingga jumlah sampel sebanyak 50 siswa. Temuan menunjukkan bahwa terdapat hubungan linier positif yang patut diperhatikan antara kapasitas memahami konsep dan prestasi pendidikan dalam bentuk aljabar, sebagaimana dibuktikan dengan koefisien korelasi sebesar 0,500. Selain itu, kontribusi kemampuan pemahaman konsep terhadap hasil belajar bentuk aljabar diperkirakan sebesar 25,00%. Koefisien korelasi antara kemampuan pemecahan masalah dengan hasil belajar aljabar sebesar 0,629 menunjukkan adanya hubungan linier positif yang kuat. Selanjutnya, kemampuan pemecahan masalah memberikan kontribusi sebesar 39,56% terhadap variansi hasil belajar aljabar. Koefisien korelasi sebesar 0,718 menunjukkan adanya hubungan linier yang kuat antara kemampuan pemahaman konsep dan keterampilan pemecahan masalah dengan hasil belajar bentuk aljabar. Selanjutnya kemampuan numerik dan kemampuan spasial secara kolektif menyumbang 51,55% terhadap prestasi matematika siswa. Berdasarkan temuan penelitian ini, diketahui bahwa gabungan pengaruh pemahaman konseptual dan keterampilan pemecahan

masalah lebih terasa dalam membentuk hasil belajar siswa kelas VII dalam bentuk aljabar di SMP N 1 Siau Timur Selatan.

Kata Kunci: *Pemahaman Konsep, Pemecahan Masalah, Hasil Belajar, Bentuk Aljabar*

Abstract

The objective of this study is to ascertain the existence and statistical significance of a potential correlation between an individual's comprehension of concepts and their achievement in acquiring algebraic forms. 2) Proficiency in problem-solving skills with a focus on achieving algebraic learning objectives. 3) Proficiency in comprehending abstract concepts and demonstrating problem-solving skills within the context of algebraic educational objectives. The present study used a correlational survey methodology. The study sample consisted of 65 students from class VII SMP N 1 Siau Timur Selatan. The data collection employed a saturated sample approach, specifically encompassing the whole student population. During the execution of the study, a total of 15 students were absent, resulting in a sample size of 50 students. The findings indicate that there exists a noteworthy positive linear association between the capacity to comprehend concepts and the educational achievements in algebraic forms, as evidenced by a correlation coefficient of 0.500. Moreover, the contribution of conceptual comprehension abilities to the learning outcomes of algebraic forms is estimated to be 25.00%. The correlation coefficient between problem solving ability and algebraic learning outcomes is 0.629, indicating a strong positive linear association. Furthermore, problem solving abilities account for 39.56% of the variance in algebraic learning outcomes. The correlation coefficient of 0.718 indicates a strong linear relationship between the capacity to comprehend concepts and problem-solving skills, and the learning outcomes in algebraic forms. Furthermore, numerical abilities and spatial abilities collectively account for 51.55% of students' mathematics achievement. Based on the findings of this study, it was determined that the combined influence of conceptual understanding and problem-solving skills is more pronounced in shaping the learning outcomes of seventh-grade students in algebraic forms at SMP N 1 Siau Timur Selatan.

Keywords: *Concept Understanding, Problem Solving, Learning Outcomes, Algebraic Forms*

INTRODUCTION

Mathematics, as an essential discipline, can be applied in various fields of human life and plays an essential role in the educational curriculum for students. Mathematics pervades everyday life because it requires careful calculations for routine actions (Hartoyo, 2015; Novitasari & Wilujeng, 2018). Therefore, in the process of learning mathematics, learning innovations from teachers are needed in teaching and learning activities to improve the quality of human resources (Siregar et al., 2017; Nurfadhillah et al., 2021; Marisana et al., 2023).

Acquiring critical, systematic, logical, and creative thinking skills is anticipated in mathematics education. This skill allows students to efficiently and quickly conclude from various

facts or data collected or already known. The ability to understand concepts in learning mathematics is needed in the learning process so that it is easy to understand and know the subject matter provided by the teacher, and this will have an impact on the results that will be obtained by students (Gusmania & Dari, 2018; Setyawati et al., 2020; Suendarti & Liberna, 2021).

One of the additional elements that is important for students in acquiring mathematical knowledge is the ability to effectively address and solve problems during the learning journey because this attribute has significant relevance when engaging with real-world scenarios. This is in line with the general objectives of mathematics education at the primary and secondary levels, which include (a) equipping students with the skills to navigate dynamic situations both in personal and global contexts by cultivating logical, rational, critical, thorough, honest, practical thinking and efficient; (b) equip students with the ability to apply mathematical concepts and mathematical mindsets in practical situations and in pursuing knowledge in various scientific disciplines (Kamarullah, 2017; Sujadi, 2019; Telaumbanua, 2020).

Understanding concepts and problem-solving skills are needed in mathematics because this can make it easier for students to understand the subject matter provided by the teacher. This will also have an impact on the learning outcomes to be achieved by students. Evaluation of student learning outcomes in mathematics education involves categorizing three main components: conceptual understanding, reasoning and communication abilities, and problem-solving abilities (Rahmadi, 2015; Agustina, 2016; Harahap & Surya, 2017). Including conceptual understanding is a fundamental component of mathematics education in the school curriculum (Sumiati & Agustini, 2020; Hartini et al., 2022). It is recognized that a strong understanding of mathematical concepts is a prerequisite for effective learning in the field (Sumiati & Agustini, 2020; Hartini et al., 2022).

The problem that requires consideration in teaching mathematics concerns the frequency of errors students make while solving mathematical problems. Students often need help solving math problems. These errors cover various fields, including a lack of understanding of mathematical concepts, the use of incorrect mathematical formulas, calculation errors, misinterpretation of symbols and signs, as well as errors in selecting and applying problem-solving procedures (Mahmudah, 2018; Hanipa & Sari, 2019; Supartinah & Hidayat, 2021). Therefore, to understand mathematical concepts, it is essential to learn the previous concepts. This means that the process of acquiring mathematical knowledge must be carried out in stages and sequentially, considering the influence of previous learning experiences (Fimansyah, 2015; Indrawati & Hartati, 2017; Ginanjar, 2019).

Algebra is an essential discipline in mathematics, along with many other disciplines. Based on insights gathered from mathematics educators and empirical observations conducted at SMP

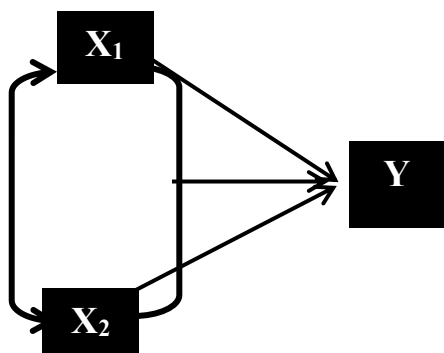
Negeri 1 Siau Timur Selatan, it is known that algebra presents significant challenges for students, leading to many errors in their problem-solving efforts. Indeed, this particular topic is a requirement for studying mathematics at an advanced level. It is not uncommon for students to encounter errors when trying to determine the results of algebraic calculations. Mistakes that students often make include: (1) not correctly determining the solution to the equation $5x - 3x + 7y = 2x + 7y$, resulting in the wrong answer $9xy$; (2) incorrectly determines the solution to equation $(x+5)(x-7)$, causing the answer $x^2 - 35$ to be incorrect; or (3) incorrectly determines the solution to the equation $(2x+5)^2$ resulting in an incorrect answer of $4x^2 + 25$. The occurrence of errors may be due to students' inherent challenges in understanding and acquiring knowledge in this subject matter. Learning challenges can arise due to a limited understanding of basic concepts. 2) Lack of interest or motivation One of the problems that arises is the need for adequate practice in answering questions. 4) difficulty solving a problem/analyzing story questions. This can be seen from the results of students' scores, which are below the Minimum Learning Completeness (KBM) in studying several forms of algebra material, and the students' learning outcomes still need to be satisfactory. To understand these symptoms, researchers will examine students' knowledge of concepts and problem-solving abilities in studying algebra material in class VII SMP Negeri 1 Siau Timur Selatan.

Based on the description above, this research was carried out to see the relationship between the ability to understand concepts and the ability to solve problems with learning outcomes in algebraic material.

METHOD

This study uses a combination of descriptive and correlational research methodologies. The research proposal will be conducted at Siau Timur Selatan 1 Public Middle School in semester I of the 2021/2022 academic year. This study's population was all class VII SMP Negeri 1 Siau Timur Selatan students in the odd semester, especially class VII A, VII B, and VII C. The researcher used a saturated sampling strategy. Participants in this study consisted of 50 students of class VII SMP Negeri 1 Siau Timur Selatan. Initially, the number of samples was 65 people, but due to the absence of 15 students during the research period, the number of final research subjects was reduced to 50.

The research design used is denoted by X_1 , X_2 , and Y and can be described as follows:



Caption :

X1 = Concept Understanding Ability

X2 = Problem Solving Ability

Y = Learning Outcomes of Algebraic Forms

Figure 1. Research Design

RESULT AND DISCUSSION

This research was conducted at SMP Negeri 1 Siau Timur Selatan, Sawang village, Siau Tagulandang Biaro Regency. The population of this research is all students in class VII of SMP Negeri 1 Siau Timur Selatan 2019/2020 academic year. In this research, the data taken is on concept understanding abilities, problem-solving abilities, and students' algebra learning outcomes. Data on students' conceptual understanding and problem-solving abilities are used to determine whether there is a relationship with algebraic learning outcomes.

1. Testing research instruments

To obtain a suitable research instrument, the researcher conducted a trial using a test instrument consisting of 15 questions on conceptual understanding ability and 5 questions on problem-solving ability. Then, an analysis test of the test instrument is carried out in the form of a validity and reliability test to determine whether the instrument is good or not so that the instrument can be tested on a sample group.

Table 1. Validity test results of the concept understanding ability instrument

No Item	r count	r table 15 resp	Description	No item	r count	r table 15 resp	Description
1	0.686	0.497	Valid	9	0.609	0.497	Valid
2	0.542	0.497	valid	10	0.598	0.497	Valid
3	0.532	0.497	Valid	11	0.148	0.497	Invalid
4	0.565	0.497	Valid	12	0.560	0.497	Valid
5	0.542	0.497	Valid	13	0.559	0.497	Valid
6	0.733	0.497	valid	14	0.180	0.497	Invalid
7	0.530	0.497	Valid	15	0.706	0.497	Valid
8	0.627	0.497	valid				

Table 2. Reliability Test Results for Understanding Concepts

Reliability Statistics	
Cronbach's Alpha	N of Items
.855	15

Table 3 below is the result of testing the validity and reliability of the problem-solving ability instrument. Validity testing by calculating Pearson Product Moment Correlation using SPSS for Windows version 22.

Table 3. Validity Test Results for Problem Solving Ability

No. Item	r count	r table 16 resp	Decision
1	0.703	0.497	Valid
2	0.646	0.497	Valid
3	0.856	0.497	Valid
4	0.822	0.497	Valid
5	0.763	0.497	Valid

After the validity test, the reliability coefficient was sought by calculating reliability using the Alpha Cronbach formula with SPSS for Windows version 22.

Table 4. Reliability Test Results for Problem-Solving Ability

Reliability Statistics	
Cronbach's Alpha	N of Items
.800	5

2. Analysis Prerequisite Testing

The data normality test is said to be normally distributed if the significance value is more than $\alpha = 5\%$ (0.05). The results of the significance value in the normality test of the ability to understand concepts and problem-solving abilities, as well as learning outcomes in algebraic forms, are 0.065. they are normally distributed.

The results of the linearity test are said to have a linear pattern if the significance is more than $\alpha = 5\%$ (0.05). The results of the linearity test of the ability to understand concepts with the results of learning algebraic forms show that the significance value on the Deviation from Linearity variable results of the linearity test of the ability to understand concepts with the results of learning algebraic forms is 0.381. Because a significance value of 0.381 was obtained, which

was more significant than 0.05, the ability to understand concepts with the learning outcomes of students' algebraic forms had a linear relationship between the variables.

In addition, the results of the linearity test of problem-solving abilities with learning outcomes of algebraic forms show that the significance value on the Deviation from the Linearity variable of the linearity test of problem-solving abilities with learning outcomes of algebraic forms is 0.106. Because a significance value of 0.106 was obtained, which was more significant than 0.05, there was a linear relationship between the variables of problem-solving ability and the learning outcomes of students' algebraic forms.

3. Hypothesis test

In this study, three hypotheses were tested, for the first and second hypotheses were tested using the Pearson simple linear correlation coefficient formula, namely looking for a relationship between the independent variable ability to understand concepts (X_1) and variables related to algebraic learning outcomes (Y), the independent variable problem-solving ability (X_2) and variables related to algebraic learning outcomes (Y). Meanwhile, the multiple linear correlation coefficient test will test the third hypothesis.

a. Hypothesis Testing 1

The hypothesis will be tested using Pearson's simple linear correlation coefficient formula. Below are presented the data processing results in Table 11 with the SPSS for Windows version 22 program.

Table 5. Correlation of Concept Understanding Ability with Learning Outcomes

		Concept Understanding Ability	Learning Outcomes of Algebraic Forms
Concept Understanding Ability	Pearson Correlation	1	.500**
	Sig. (2-tailed)		.000
	Sum of Squares and Cross-products	8768.180	3779.120
	Covariance	178.942	77.125
	N	50	50
Learning Outcomes of Algebraic Forms	Pearson Correlation	.500**	1
	Sig. (2-tailed)	.000	

Sum of Squares and Cross-products	3779.120	6504.080
Covariance	77.125	132.736
N	50	50

** . Correlation is significant at the 0.01 level (2-tailed).

Based on Table 5, it can be seen that the correlation coefficient between the variables X1 and Y is 0.500. The result is the same as the manual calculation.

b. Hypothesis Testing 2

The Hypothesis will be tested using the Pearson simple linear correlation coefficient formula. The following presents the results of processed data in Table 13 using the SPSS for Windows version 22 program.

Table 6. Correlation of problem-solving abilities with algebraic learning outcomes

		Concept Understanding Ability	Learning Outcomes of Algebraic Forms
Concept Understanding Ability	Pearson Correlation	1	.629**
	Sig. (2-tailed)		.000
	Sum of Squares and Cross-products	11317.780	5395.320
	Covariance	230.975	110.109
	N	50	50
Learning Outcomes of Algebraic Forms	Pearson Correlation	.629**	1
	Sig. (2-tailed)	.000	
	Sum of Squares and Cross-products	5395.320	6504.080
	Covariance	110.109	132.736
	N	50	50

** . Correlation is significant at the 0.01 level (2-tailed).

Based on Table 5, it can be seen that the correlation coefficient between the variables X1 and Y is 0.629. The result is the same as the manual calculation.

c. Hypothesis testing 3

The hypothesis will be tested using multiple correlation analysis to find the magnitude of the relationship between the concept understanding ability variable (X_1) and the problem-solving ability variable (X_2) with the algebra form learning outcome variable (Y). Below are presented the data processing results in Table 15 with the SPSS for Windows version 22 program.

Table 7. Correlation of concept understanding ability and problem-solving ability with algebraic learning outcomes

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.718 ^a	.515	.494	8.192	.515	24.957	2	47	.000
a. Predictors: (Constant), Kemampuan Pemecahan Konsep, Kemampuan Pemecahan Masalah									

Based on Table 7, it can be seen that the correlation coefficient between the variables X_1 and Y is 0.718. The result is the same as the manual calculation.

Based on the results presented above, based on hypothesis testing, there is a positive linear relationship between the ability to understand concepts and the learning outcomes of class VII algebra at SMP Negeri 1 Siau Timur Selatan. The correlation coefficient of the variable ability to understand concepts with the learning outcomes of students' algebraic forms is 0.500 with sufficient interpretation. The variable contribution of the ability to understand concepts with the results of learning algebraic forms of students is 25.00%. Based on the significance of $t_{count} = 4 \geq t_{table} = 1.677$, the alternative hypothesis H_{a1} is accepted (reject H_0). The results state a significant positive linear relationship between the ability to understand concepts and the algebra learning outcomes of class VII students at SMP Negeri 1 Siau Timur Selatan. This is based on the correlation between the ability to understand concepts and students' algebra learning outcomes from research conducted on class VII students at SMP Negeri 1 Siau Timur Selatan.

Apart from that, a positive linear relationship exists between problem-solving abilities and the algebra learning outcomes of class VII students at SMP Negeri 1 Siau Timur Selatan. The correlation coefficient of the problem-solving ability variable with the learning outcomes of

students' algebraic forms is 0.629, with a strong interpretation. The contribution of the problem-solving ability variable to the learning outcomes of students' algebraic forms is 39.56%. Based on the significance of $t_{count} = 5.609 \geq t_{table} = 1.677$, the alternative hypothesis H_{a2} is accepted (reject H_0). The results state a significant positive linear relationship between problem-solving abilities and the algebra learning outcomes of class VII students at SMP Negeri 1 Siau Timur Selatan. This is based on the significant correlation between problem-solving abilities and the algebra learning outcomes of class VII students at SMP Negeri 1 Siau Timur Selatan.

So, there is also a linear relationship between the ability to understand concepts and the ability to solve problems with the algebra learning outcomes of class VII students at SMP Negeri 1 Siau Timur Selatan. The correlation coefficient of concept understanding and problem-solving ability with students' algebra learning outcomes is 0.718, with a strong interpretation. The variable contribution of concept understanding ability and problem-solving ability to algebra learning outcomes is 51.55%, while factors outside concept understanding ability and problem-solving ability influence 48.45%. Based on the significance of $F_{count} = 25.7 > F_{table} = 3.20$, the alternative hypothesis H_{a3} is accepted (reject H_0). The results state a significant linear relationship between the ability to understand concepts and problem-solving abilities and the algebra learning outcomes of class VII students at SMP Negeri 1 Siau Timur Selatan. This study has a close relationship between the ability to understand concepts and the ability to solve problems. Because these two variables have a relationship, any changes in the ability to understand concepts and problem-solving abilities can influence students' algebra learning outcomes, especially in class VII of SMP Negeri 1 Siau Timur Selatan.

Based on these three hypotheses, it can be concluded that understanding concepts and good problem-solving skills together can improve the algebra learning outcomes of class VII students at SMP Negeri 1 Siau Timur Selatan.

CONCLUSION

Based on the results of the research that has been carried out and described, the following conclusions can be drawn:

1. A significant positive relationship exists between the ability to understand concepts and the results of learning algebraic forms of SMP Negeri 1 Siau Timur Selatan class VII students.
2. There is a significant positive relationship between problem-solving abilities and learning outcomes of algebraic forms of class VII students of SMP Negeri 1 Siau Timur Selatan.

3. A significant positive relationship exists between the ability to understand concepts and problem-solving abilities with the results of learning algebraic forms of class VII students of SMP Negeri 1 Siau Timur Selatan.

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