



## *Mathematical Understanding Concept Ability of Junior High School Students on Algebra*

### **Kemampuan Pemahaman Konsep Matematis Siswa Tingkat Sekolah Menengah Pertama pada Bentuk Aljabar**

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#### **Abstract**

*Mathematical understanding concept ability must be possessed by students in learning mathematics. This study describes students' ability to understand algebraic concepts. The research method used was qualitative research with research subjects of 30 grade VII MTs TPI Sawit Seberang students. Data was collected through observation, interviews, and documentation. The results showed that students' ability to understand mathematical concepts was still low. Only two indicators have a good rate, namely restating the concept by 67% and giving examples instead of examples by 60%. Students have difficulty in distinguishing elements of algebraic forms, substituting equations, and calculating operations in algebraic form. Schools must be able to facilitate students in learning activities so that students have a good understanding of mathematical concepts.*

**Keywords:** Algebra Form; Mathematical Concepts Ability.

#### **Abstrak**

*Kemampuan pemahaman konsep matematika harus dimiliki siswa dalam belajar matematika. Penelitian ini mendeskripsikan kemampuan siswa memahami konsep aljabar. Metode penelitian yang digunakan adalah penelitian kualitatif dengan subyek penelitian 30 siswa kelas VII MTs TPI Sawit Seberang. Data dikumpulkan melalui observasi, wawancara, dan dokumentasi. Hasil penelitian menunjukkan kemampuan pemahaman konsep matematika siswa masih rendah. Hanya dua indikator yang tingkat ketercapaiannya bagus, yakni menyatakan ulang konsep sebesar 67% dan memberi contoh dan bukan contoh sebesar 60%. Siswa kesulitan dalam membedakan unsur-unsur bentuk aljabar, mensubstitusi persamaan, dan menghitung operasi dalam bentuk aljabar. Sekolah harus mampu memfasilitasi siswa dalam kegiatan pembelajaran sehingga siswa memiliki pemahaman konsep matematika yang baik.*

**Kata Kunci:** Bentuk Aljabar; Kemampuan Pemahaman Konsep Matematis.

## Introduction

Mathematics is also a subject that plays an important role in education. Learning mathematics can train students' abilities in thinking, reasoning, negotiating, and solving problems. According to Sugiyono, students' mathematics skills are categorized into five main skills: understanding, problem solving, communication, reasoning, and connection. Therefore, it is necessary to improve students' understanding of mathematics learning. Understanding is the first skill that students must develop when learning mathematics. Susanto explained that understanding is a process where you can explain something and provide a creative explanation by providing pictures and examples with a more in-depth explanation. Current concepts exist in thoughts, ideas, and emotions. Therefore, if a student is able to perform calculations and change one form to another by using mathematical formulas strategically or by applying symbols that represent concepts, then he will be equipped with the ability to understand concepts<sup>1</sup>. These three components form the basis of conceptual understanding of coordinate and transformation geometry.<sup>2</sup>

Students in mathematics classes must develop their mathematical understanding, which is very important.<sup>3</sup> The reason why the ability to understand mathematics is important is because it is one of the goals of learning mathematics in junior high school. (KTSP 2006 and Curriculum 2013) and in NCTM (1989). This statement is in line with Fudoyo's opinion that the aim of teaching mathematics is for students to understand the knowledge provided. Good teaching is an effort that successfully guides students towards the goals they want to achieve, an effort that allows them to fully understand the content presented to them<sup>4</sup>.

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<sup>1</sup> Mochammad Maulana Trianggono, "Analisis Kausalitas Pemahaman Konsep Dengan Kemampuan Berpikir Kreatif Siswa Pada Pemecahan Masalah Fisika," *Jurnal Pendidikan Fisika dan Keilmuan (JPFK)* 3, no. 1 (26 April 2017): 1, <https://doi.org/10.25273/jpfk.v3i1.874>.

<sup>2</sup> Fourrie Malatjie dan France Machaba, "Exploring Mathematics Learners' Conceptual Understanding of Coordinates and Transformation Geometry through Concept Mapping," *EURASIA Journal of Mathematics, Science and Technology Education* 15, no. 12 (7 November 2019), <https://doi.org/10.29333/ejmste/110784>.

<sup>3</sup> Muhammad Noor Kholid dkk., "How Are Students' Conceptual Understanding for Solving Mathematical Problem?," *Journal of Physics: Conference Series* 1776, no. 1 (1 Februari 2021): 012018, <https://doi.org/10.1088/1742-6596/1776/1/012018>.

<sup>4</sup> Heris Hendriana, Euis Eti Rohaeti, dan Utari Sumarno, *Hards Skills dan soft Skills Matematika Siswa* (Bandung: Refika Aditama, 2017).

Understanding mathematical concepts refers to students' ability to understand concepts and carry out procedures (algorithms) flexibly, accurately, efficiently, and precisely. The ability to understand mathematical concepts is the ability to absorb the meaning of the mathematical content being studied. Applying mathematical understanding is important for students to learn mathematics meaningfully.

According to the technical explanation of the Regulations of the Director General of Basic Education, Ministry of National Education, there are five indicators included in the ability to understand concepts, including: restating a concept; giving examples and non-examples; presenting concepts in various mathematical representations; using utilising, and selecting certain procedures; and applying concepts/algorithms to problem solving.

Algebra is one of the teaching materials used when learning mathematics. Algebraic form is one of the materials that must be mastered by class VII junior high school students as initial knowledge for studying the next material. Algebra is a subject matter and is important for class VII students to learn because it can contribute to advanced mathematics material and in real life.<sup>5</sup> Algebra focuses on helping students master symbols, operations, rules, and become proficient in the use of notation. Because algebra involves solving systems of equations, finding unknown values, using quadratic formulas, or using quadratic formulas, and more. A written system of mathematical formulas, equations, and symbols. If you are an educated person, you have probably used algebraic concepts. Algebraic concepts appear indirectly in everyday problems. Understanding concepts is very important when studying algebra. Understanding concepts makes learning more meaningful for students. Students can not only memorise and apply formulas, but also understand technical concepts.

As the results of research by Klorina dan Prabanto (2023) bahwa students often get confused when determining the elements of algebraic forms, students still make mistakes when simplifying algebraic forms because they confuse positive and negative signs with addition and subtraction operations, students cannot interpret story problems in the form of mathematical representations, and students do not understand story problems. when solving questions related to one concept and another. This is because students only memorize formulas and rarely repeat material previously taught so that the results are less than optimal<sup>6</sup>.

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<sup>5</sup> Silfina Ihza Hayati dan Rina Marlina, "Analisis Kemampuan Pemahaman Konsep Matematis Siswa Kelas VII SMP pada Materi Bentuk Aljabar di SMP IT Nurul Huda Batujaya," *Jurnal Pembelajaran Matematika Inovatif* 4, no. 4 (2021): 827-34, <https://doi.org/10.22460/jpmi.v4i4.827-834>.

<sup>6</sup> Meicindy Jeny Klorina dan Sufyani Prabawanto, "Kemampuan Pemahaman Konsep Matematis Siswa dalam Menyelesaikan Soal Bentuk Aljabar," *AKSIOMA: Jurnal Program Studi*

There have been several studies related to the ability to understand mathematical concepts in algebra material, including research by Imam Sugito and Indrie Noor Aini (2019) with the title: "Analysis of Class VII Students' Understanding of Mathematical Concepts in Algebra Material". The results of this research showed that the results were still below average, so it was concluded that students' ability to understand mathematical concepts was still relatively low<sup>7</sup>.

Research by Rina Nur Anisa, Angra Meta Ruswana and Lala Nailah Zamnah (2021) show that: 1) Almost all students in the low, medium and high categories are able to remember and apply formulas regularly and calculate simply; 2) Students with moderate and high mathematical understanding abilities tend to be able to apply formulas and carry out calculations correctly. Meanwhile, students with low mathematical abilities are not yet able to apply formulas and carry out calculations correctly; 3) Almost all students in the low, medium, and high categories have not been able to prove the truth of a formula or theorem; and 4) Almost all students in the medium, low, and high categories are able to estimate the correctness of the formula (answer) although there are some students who are less able to estimate with certainty the formula to be used<sup>8</sup>. Research conducted by Kesi Septriyani and Chandra Novtiar (2021) aimed to describe the ability to understand mathematical concepts of class VII MTs students. An Naiim Bandung on algebra form material concluded that the test results obtained for students' ability to understand mathematical concepts were still relatively low<sup>9</sup>.

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*Pendidikan Matematika* 12, no. 2 (21 Juni 2023): 1714, <https://doi.org/10.24127/ajpm.v12i2.7598>.

<sup>7</sup> Imam Sugito dan Indrie Noor Aini, "Analisis Kemampuan Pemahaman Konsep Matematis Siswa Kelas VIII Pada Materi Aljabar," *Prosiding Seminar Nasional Matematika dan Pendidikan Matematika Sesiomadika 2019*, 2019.

<sup>8</sup> Rina Nur Anisa, Angra Meta Ruswana, dan Lala Nailah Zamnah, "Analisis Kemampuan Pemahaman Konsep Matematis Peserta Didik SMP pada Materi Aljabar," *J-KIP (Jurnal Keguruan dan Ilmu Pendidikan)* 2, no. 3 (30 Oktober 2021): 237, <https://doi.org/10.25157/j-kip.v2i3.6271>.

<sup>9</sup> Kesi Septriyani dan Chandra Novtiar, "Analisis Kemampuan Pemahaman Konsep Matematis Siswa Kelas VII pada Materi Bentuk Aljabar di Masa Pandemi Covid-19," *Jurnal Pembelajaran Matematika Inovatif* 4, no. 6 (2021): 1709-22, <https://doi.org/10.22460/jpmi.v4i6.1709-1722>.

Research by Sri Wahyu Purwaningsih and Rina Marlina (2022), which aims to describe students' ability to understand mathematical concepts in algebra form material in class VII students at SMP Negeri 4 Tambun Utara Bekasi, concluded that students' ability to understand mathematical concepts varies and the majority are in the category Enough<sup>10</sup>. Research by Meicindy Jeny Klorina and Sufyani Prabawanto (2023), which aims to describe students' ability to understand mathematical concepts in class VII algebra form questions at SMPN in Bengkulu City, concluded that students often get confused when determining the elements of algebra form, students still make mistakes when simplifying algebraic forms because they confuse positive and negative signs with addition and subtraction operations, students cannot interpret story problems in the form of mathematical representations, and students do not understand story problems when solving problems related to one concept or another<sup>11</sup>.

None of these studies have investigated in detail the ability to understand concepts using indicators of the ability to understand mathematical concepts. To measure the level of ability to understand mathematical concepts in detail, indicator of ability to understand mathematical concepts is needed. Measuring the ability to understand mathematical concepts based on indicators provides detailed results about students' abilities in the material presented. The aim of this research is to analyse the results of tests on students' ability to understand mathematical concepts and will be assessed based on indicators of the ability to understand mathematical concepts based on the Regulations of the Director General of Basic Education, Ministry of National Education.

## Method

The research method used in this research is qualitative research. The subjects of this research were 30 class VII students at MTs TPI Sawit Seberang. Observation, interviews, and documentation were used as data collection techniques in this research. In the observation method, researchers only observe the classroom situation during the teaching and learning process, observe certificates, and observe the ability to understand mathematical concepts in algebra material.

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<sup>10</sup> Purwaningsih dan Marlina, "Analisis Kemampuan Pemahaman Konsep Matematis Siswa SMP Kelas VII pada Materi Bentuk Aljabar."

<sup>11</sup> Klorina dan Prabawanto, "Kemampuan Pemahaman Konsep Matematis Siswa dalam Menyelesaikan Soal Bentuk Aljabar."

In the interview method, researchers use semi-structured interviews to find more open questions. Data analysis in qualitative research occurs before entering the field, during the field visit, and after the field visit ends. Data analysis was carried out at the data reduction, data presentation, and conclusion drawing stages. The reduction stage of this research includes modifying the results of students' work in tests of ability to understand mathematical concepts, determining students to be research subjects, and conducting interviews with several Class VII students. Simplifications of results are included. This will be shorter and clearer. After the data has been reduced, the next step is to plot the data. This is done so that the data collected is clearer and conclusions are easier to draw. Conclusions are drawn by comparing the results of observations with the results of student work and interviews, so that conclusions can be drawn about students' ability to understand mathematical concepts in algebra material.

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Indicators of students' ability to understand mathematical concepts include:

1. restating a concept,
2. giving examples and non-examples,
3. presenting concepts in various representations,
4. using, utilizing, and choosing certain procedures, and
5. applying concepts to problem solving.

## Results and Discussion

After testing the ability to understand mathematical concepts on 30 students who had been selected, they took 60 minutes to work. Then the data is processed and analyzed. The test results are grouped based on indicators of students' ability to understand mathematical concepts as follows.

Table 1. Student Test Results Based on Indicators of Ability to Understand Mathematical Concepts

No	Indicator	Many Students	Percentage
1	Restate a concept	20	67%
2	Give examples and non-examples	18	60%
3	Presenting concepts in various mathematical representations	10	33%
4	Using, utilising, and selecting certain procedures	8	27%
5	applying concepts to problem solving	2	6%

Based on the Table 1, students' ability to understand mathematical concepts is generally low due to their failure to answer more than 50% of these two indicators correctly. The most correct answer is in the first indicator, namely "giving an example, not giving an example", and the fewest correct answer are in the fifth indicator, namely "applying concepts/algorithms to solve problems".

Below is shown the percentage of students' mathematical concept understanding ability test results in Figure 1.

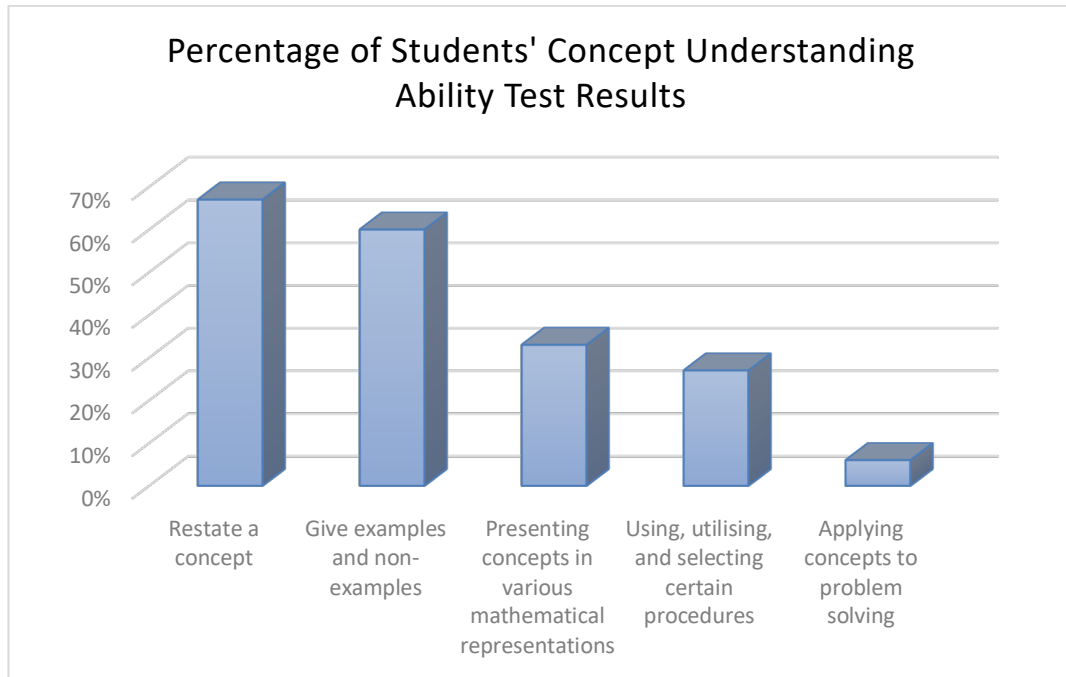


Figure 1. Percentage of Students' Concept Understanding Ability Test Results

1. Indicator 1 "restates a concept"

The results of student responses to question no. 1 using the indicator "restate a concept" show that students make mistakes in determining the elements of algebraic forms. Because students feel confused when distinguishing algebraic elements such as variables, coefficients, and constants, students often answer incorrectly or are confused. Only 20 students answered correctly, and 10 students answered incorrectly.

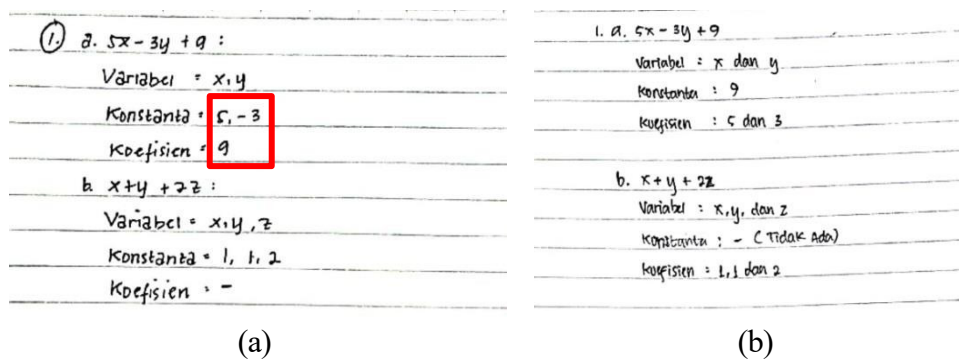


Figure 1. Student answers to indicator 1

In Figure 1(a), students are still confused between coefficients and constants and are unable to differentiate between the two so the answer is wrong. However, students already know what these variables mean. In Figure 1(b), this is the correct answer. Students can differentiate between variables, coefficients, and constants. About the ability to reformulate concepts. The



results of interviews with students who answered incorrectly stated that students were still confused in determining coefficients and constants. In accordance with Hayati & Marlina (2021) results of interviews with students who find difficulties including: difficulty in distinguishing elements that exist in algebraic form, difficulties in substituting equations, and difficulties in arithmetic operations in algebraic forms.<sup>12</sup>

## 2. Indicator 2 "gives examples and not examples"

For question no. 4 indicators "give examples, don't give examples", 18 students were able to choose and determine which examples were included in the questions and which were not. Below is an example of a student's response to question number 4.

(a)
(b)

Figure 2. Student answers for Indicator 2

In Figure 2(a) the answer is correct, but students who only correct and blame do not correct the wrong questions. In contrast, in Figure 2(b), students answered the correct answer and corrected the incorrect answer as correct. The results of interviews with students who answered incorrectly stated that students were still confused in determining coefficients and constants. The results of interviews with students who answered incorrectly stated that students were still confused in understanding how to apply algebra concepts. This measure assesses students' conceptual understanding as good, which states that conceptual understanding is the ability to find abstract ideas, group objects into concepts, and summarize them into examples and non-examples.<sup>13</sup>

<sup>12</sup> Hayati dan Marlina, "Analisis Kemampuan Pemahaman Konsep Matematis Siswa Kelas VII SMP pada Materi Bentuk Aljabar di SMP IT Nurul Huda Batujaya."

<sup>13</sup> Hanifah Hanifah dan Agung Prasetyo Abadi, "Analisis Pemahaman Konsep Matematika Mahasiswa dalam Menyelesaikan Soal Teori Grup," *Journal of Medives : Journal of Mathematics Education IKIP Veteran Semarang*2, no. 2 (5 Juli 2018): 235, <https://doi.org/10.31331/medives.v2i2.626>.

3. Indicator 3 "presents concepts in various mathematical representations"

Regarding the indicator for question 2 "presenting concepts in different mathematical representations", only 10 students answered this question correctly. Below is an example of a student response to question 2.

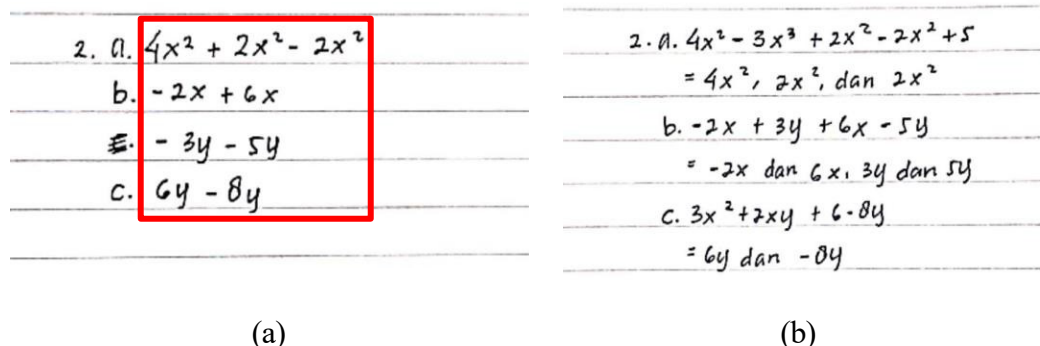


Figure 3. Student Answers for Indicator 3

Figure 3(a) is still wrong and the concept cannot be explained in a different representation, but in Figure 3(b) the answer is correct and the concept can be explained in a different representation. The questions above correspond to indicators of the ability to express concepts in various forms of mathematical representation. Regarding the indicator for question number 2 "Representation of concepts through various mathematical expressions" there are still many wrong answers because many students are less able to comprehend and comprehend the question when working on question number 2. The results of interviews with students who answered incorrectly stated that students were still confused about applying algebraic concepts in other forms. Consistent with the research results of Suraji et al (2018), students are less involved and have difficulty presents concepts to understand mathematical concepts.<sup>14</sup>

<sup>14</sup> Suraji Suraji, Maimunah Maimunah, dan Sehatta Saragih, "Analisis Kemampuan Pemahaman Konsep Matematis dan Kemampuan Pemecahan Masalah Matematis Siswa SMP pada Materi Sistem Persamaan Linear Dua Variabel (SPLDV)," *Suska Journal of Mathematics Education* 4, no. 1 (1 Mei 2018): 9, <https://doi.org/10.24014/sjme.v4i1.5057>.

4. Indicator 4 "using, utilizing, and choosing certain procedures"

The indicator in question 3 which includes "using, utilizing, and choosing certain procedures" was only answered correctly by eight students. Below is an example of a student's response to question number 3.

$  \begin{aligned}  &3. 10x^2 + 3xy - 5y^2 - 7x^2 - 10xy - 2y^2 \\  &= 10x^2 - 7x^2 + 3xy - 10xy - 5y^2 - 2y^2 \\  &= 3x^2 - 7xy - 7y^2  \end{aligned}  $	$  \begin{aligned}  &3. 10x^2 + 3xy - 5y^2 - 7x^2 - 10xy - 2y^2 \\  &= 10x^2 - 7x^2 + 3xy - 10xy - 5y^2 - 2y^2 \\  &= 3x^2 - 7xy - 7y^2  \end{aligned}  $
(a)	(b)

Figure 4. Students' answers to indicator 4

In Figures 4(a) and (b), the answer is correct. The questions above discuss indicators of the ability to use, utilize and choose certain procedures, thereby enabling students to choose and use procedures based on the questions asked. Indicator for question number 3: "Use, exploit, and choose certain procedures. Contrary to Magfila's findings, we found that students made errors when they were unable to design appropriate formulas.

5. Indicator 5 "applies concepts/algorithms to problem solving"

For indicator question no. 5, "Applying concepts/algorithms to solve problems," only two students solved the problem correctly. Below is an example of a student's answer to question number 5.

$  \begin{aligned}  &5. a. (2x+3y) + (-6x+12y) \\  &= (2x-6x) + (3y+12y) \\  &= -4x + 15y \\  &b. (p-3q-r) + (5p+3q+r) \\  &= p+5p-3q+3q-r+r \\  &= 6p-0-0  \end{aligned}  $	$  \begin{aligned}  &5. a. 2x+3y \text{ dan } -6x+12y \\  &= -4x+15y  \end{aligned}  $
(a)	(b)

Figure 5. Student Answers for Indicator 5

In Figure 5(a), the answer is correct and according to the procedure. However, in Figure 5(b), the student gave the wrong answer and did not use the correct procedure. Indicator question number 5: "Application of concepts/algorithms to solve problems". Even though there are students who answer correctly, there are still students who answer incorrectly because they do not apply algorithmic processes when solving questions. The results of interviews with students who answered incorrectly stated that students were still confused about applying the concept of algebraic forms in answering questions. Consistent with Ario's research, he found that there was an inaccurate understanding of the problem and errors in the calculation process, as well as confusion in determining which formula to use<sup>15</sup>.

Therefore, the results of these answers indicate that when learning mathematics in algebraic material, the ability to understand concepts is still low, so that student learning achievement is still below the KKM. Based on Unikartica's information, it was concluded that the learning outcomes of class VII students at SMP Negeri 1 Banda Aceh were found to be very low. Similar research conducted by Mulyani et al (2018) revealed through their research findings that class VIII students at SMPS West Bandung Regency were still unable to understand the concepts in solving algebra problems.

Based on the results of tests and interviews with students, several difficulties faced by students were identified in the algebra material studied. These include: difficulty distinguishing elements of algebraic form such as variables, coefficients, and constants, difficulty substituting equations they already know and difficulty in arithmetic operations in algebraic form.

## Conclusion

The research results show that only two indicators were answered correctly by more than 50% of students, namely 67% for indicator 1 and 60% for indicator 2, so that each indicator can still be classified as low. Meanwhile, for Indicators 3, 4, and 5, the correct answer rates were 33%, 27%, and 6% respectively, still below 50%.

Based on interviews, students experienced difficulties such as difficulty in distinguishing elements in algebraic form, difficulty in substituting equations, and difficulty in carrying out computational operations in algebraic form. Schools should be able to provide a learning process that can improve students' ability to understand mathematical concepts by conveying understanding based on competency indicators.

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<sup>15</sup> Eka Kurnia Lestari dan Mokhammad Ridwan Yudhanegara, *Penelitian Pendidikan Matematika* (Bandung: Refika Aditama, 2015).

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