Jurnal Perspektif
Vol. 9 No.2 November 2025
Page 283-293

Analyzing Mathematical Problem Solving and Critical Thinking Abilities Through Problem Based Learning at Junior High School Students

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Received: 30 April 2025; Accepted: 27 Mei 2025

DOI: http://dx.doi.org/10.15575/jp.v9i2.361

Abstrak

Tujuan penelitian ini untuk mengetahui kemampuan pemecahan masalah dan berpikir kritis melalui pembelajaran berbasis masalah. Kerangka kerja pembelajaran berbasis masalah mendukung bakat kemampuan dengan membentuk pemikiran siswa. Penelitian ini melibatkan siswa kelas VIII-A SMP PGRI 4 Medan. Pendekatan penelitian menggunakan deskriptif kualitatif. SMP PGRI 4 Medan menjadi lokus penelitian 2024/2025. Penelitian ini menggunakan wawancara dan penilaian pemecahan masalah dan berpikir kritis. Hasil penelitian menunjukkan bahwa kemampuan pemecahan masalah matematika siswa rata-rata 65, yang sedang. Berpikir kritis siswa rata-rata 66,9, yang sedang. Kesulitan yang dihadapi siswa dengan perbandingan hasil wawancara dapat diketahui bahwa siswa mengalami kesulitan pada keempat indicator kemampuan pemecahan masalah dan berpikir kritis. Di mana siswa mengabaikan atau tidak memeriksa ulang atau menarik kesimpulan dan hanya berkonsentrasi pada prosedur solusi. Studi ini menunjukkan bahwa siswa memiliki keterampilan pemecahan masalah dan berpikir kritis sedang ketika berhadapan dengan sistem persamaan linear dua variabel.

***Kata kunci**: Berpikir Kritis, Model Pembelajaran Berbasis Masalah, Pemecahan Masalah Matematis.*

Abstract

The purpose of this study was to determine the ability to solve problems and think critically through problem-based learning. The problem-based learning framework supports talent abilities by shaping students' thinking. This study involved students of class VIII-A SMP PGRI 4 Medan. The research approach used descriptive qualitative. SMP PGRI 4 Medan became the locus of the 2024/2025 research. This study used interviews and assessments of problem solving and critical thinking. The results showed that students' mathematical problem solving abilities averaged 65, which was moderate. Students' critical thinking averaged 66.9, which was moderate. The difficulties faced by students by comparing the results of the interview can be seen that students have difficulties in the four indicators of problem solving and critical thinking abilities. Where students ignore or do not recheck or draw conclusions and only concentrate on the solution procedure. This study shows that students have moderate problem solving and critical thinking skills when dealing with a system of linear equations of two variables.

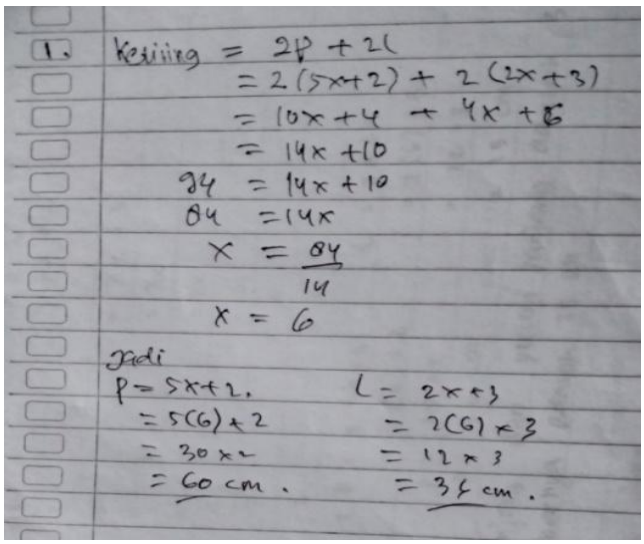
Keywords: Critical Thinking, Problem Based Learning Model, Mathematical Problem Solving.

A. Introduction

Study groups, problem-based learning, questions, and others may create a productive learning environment. Many use problem-based learning strategies to increase students' reasoning, problem-solving, critical thinking, creativity, communication, and teamwork. According to (Trianto., 2017), the problem-based learning methodology challenges genuine learning resources to build knowledge. This technique utilizes actual issues to teach, starts with a genuine problem and requires students to solve it, and employs groups or people to make learning more dynamic and creative (Marhamah, 2017).

Problem-based learning is relevant to life, particularly to the workplace, where students' everyday lives are included. This strategy also improves kids' cognitive abilities by practicing problem-solving (Nurullita., Surya, Edy. & Syahputra, 2017). This problem-based learning technique is ideal for classroom learning. This problem-based learning paradigm should help students gain 21st-century skills. The 21st century requires critical thinking, problem-solving, communication, teamwork, innovation, citizenship, and leadership. Students need critical thinking and problem-solving skills to solve arithmetic difficulties (Mahmudi, 2018).

Critical thinking refers to the ability to think logically, while problem solving refers to the pupils' ability to solve difficulties (Ndiung, Sabina & Jediut, 2020). The mathematics learning approach in class VIII of SMP PGRI 4 Medan looks to employ the 2013 curriculum and include students. It didn't go as planned (Permendikbud, 2016). Classroom learning employs the same methodology for all subjects. Some pupils struggle to solve problems because the instructor does not provide enough material and support. Such behaviour indicates poor critical thinking among kids. An observation assessed SMP PGRI 4 Medan students' problem-solving and critical thinking abilities. In the observation, pupils answered numerous questions independently. Students used their knowledge to answer the questions after receiving them. Students answered.



1. Students do not write down the information received from the questions,
2. Students do not make proper problem-solving plans, and
3. Lack of student understanding in analyzing questions.

Figure 1. Average Score of Students' Answers

Based on the observation results, none of the 30 students managed to complete the questions and answer them in the manner mentioned. Most students were unable to think critically to answer question 1 and were fixated on the question. Only 10% of students were able to complete the question but did not follow the procedure. As many as 90% of the other students were unable to complete the question and gave the same answer (Hidayat, 2012). The data above shows that students lack problem-solving and critical thinking skills to answer questions. This is indicated by the failure of students to meet Ennis' five critical thinking indicators: providing simple explanations, strengthening basic skills, drawing conclusions, illustrating further, and developing plans and tactics. Signs of Polya's problem solving include understanding the question, determining a strategy or solution plan, solving the problem according to plan, and rechecking the answer (Polya, 1973).

Study groups, problem-based learning, questions, and others may create a productive learning environment (Fardani, Z., Surya, 2021). Many use problem-based learning strategies to increase students' reasoning, problem-solving, critical thinking, creativity, communication, and teamwork. According to (Sungur, S., Tekkaya, C., & Geban, 2018), the problem-based learning methodology challenges genuine learning resources to build knowledge. This technique utilizes actual issues to teach, starts with a genuine problem and requires students to solve it, and employs groups or people to make learning more dynamic and creative.

The application of this problem-based learning model is expected to enable students to develop their abilities in the 21st century (Sabilli Firman Syah, 2024). There are several abilities that must be possessed in the 21st century, namely critical thinking and problem solving, communication skills, collaboration, creativity, citizenship, and leadership. In solving problems in mathematics that are relevant to developing the abilities that students must have are critical thinking and problem solving (Siregar, M. N. N. dan Aghni, 2021). Where critical thinking is the ability of a person or student to think rationally, while problem solving is the ability of students to solve problems or get a solution to a problem they face.

Critical thinking refers to the ability to think logically, while problem solving refers to the pupils' ability to solve difficulties (Abrami, P.C., Bernard, R.M., Borokhovski, E., Waddington, D.I., Wade, C.A., & Persson, 2015). The mathematics learning approach in class VIII of SMP PGRI 4 Medan looks to employ the 2013 curriculum and include students. It didn't go as planned. Classroom learning employs the same methodology for all subjects (Barr, D., 2019). Some pupils struggle to solve problems because the instructor does not provide enough material and support. Such behaviour indicates poor critical thinking among kids. An observation assessed SMP PGRI 4 Medan students' problem-solving and critical thinking abilities. In the

observation, pupils answered numerous questions independently. Students used their knowledge to answer the questions after receiving them. Students answered as follows (Nurullita., Surya, Edy. & Syahputra, 2017).

The relationship between critical thinking skills and problem-solving skills according to (Pakpahan, R., & Fitriani, 2020) that the results of the research that has been conducted contain the conclusion that high school students in grade X tend to have moderate mathematical critical thinking skills. This has an impact on the ability to solve problems in mathematics. Furthermore, the results of the test found that students have low critical thinking skills and have not met the indicators of implementing plans and looking back. In other words, the level of critical thinking skills affects the way mathematical problems are solved. The higher the critical thinking skills, the better the students' mathematical problem-solving skills, so problem-solving skills can be viewed from critical thinking skills (Simamora, R. E., Saragih, S., & Hasratuddin, 2018).

Students' quantitative problem-solving abilities improve with critical thinking skills. A system of linear equations with two variables requires thought (Amalia., Surya, E and Syahputra, 2017). Daily living presents two-variable linear equation difficulties (Hendrikson R Panjaitan, 2023). When solving linear equations, students must think critically. Starting with a two-variable linear equation system and solving problems utilizing substitution, elimination, combination, and graphics (Gibby, 2013). Student failure to comprehend the issue will result in the two-variable linear equation solution. Learning this content requires greater student engagement to develop critical thinking. The description above intrigues scholars to study "Analysis of Problem Solving and Critical Thinking Skills through the Application of Problem-Based Learning Models at SMP PGRI 4 Medan."

B. Research Method

The type of research used in this study is qualitative descriptive research (Moleong, 2017). We conducted this research at SMP Swasta PGRI 4 Medan, specifically class VIII, during the 2024/2025 school year. The reason the researcher chose the school was the results of initial research/observations showed that the problem-solving and critical thinking abilities of students in mathematics at SMP Swasta PGRI 4 Medan were still relatively low. The subjects of the study were class VIII of SMP, consisting of 24 students using a purposive sampling method. The object of this study was the problem-solving and critical thinking abilities of students in mathematics who were given problem-based learning treatment. The procedures used in this study include three stages, namely: (1) the stage of preparing learning devices and research instruments; (2) the stage of validating learning devices and research instruments and testing research instruments; and (3) the stage of implementing research and data analysis. Each stage is designed in such a way that valid data is obtained according to the research objectives. Prepare a plan for each stage in the study. The research instruments include problem-solving

ability tests, critical thinking ability tests, and interview guidelines. The data analysis technique used in this study is qualitative data analysis. Meanwhile, the analysis in the qualitative approach used in this study follows the model given by Miles and Huberman. A similar thing was conveyed by (Sugiyono, 2018)"It consists of three interactive activity flows that occur continuously until completion.

C. Result and Discussion

Based on the test results given to measure students' mathematical problem solving abilities, the level of students' problem solving abilities studied and analyzed based on the achievement of the indicators is described as follows. From the description of the achievement of the four indicators, it can be described by the distribution of students' abilities in students' mathematical problem solving abilities through the average score of the problem solving ability test that has been carried out and analyzed. Based on the research data of the results of the problem solving and critical thinking ability test and the results of observations on the subjects and selected as students who will be analyzed qualitatively from students with high, medium and low abilities. Here are the answers and analysis of the written test. As for the Analysis of the Answers to the Level of Ability of Students' Mathematical Problem Solving and Critical Thinking in the High Category

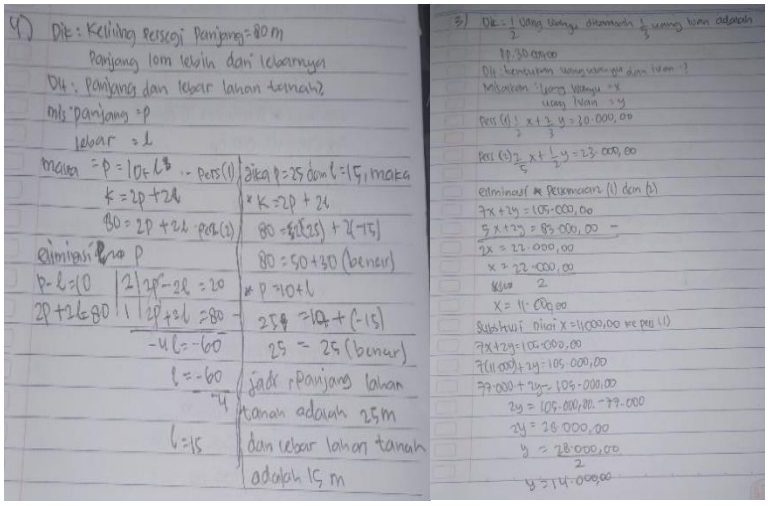


Figure 2. Analysis of high-level student answers

Based on the explanation of the interview excerpt, Subject S20 has a response and includes at least one response from the validated indicators, but when explaining about making conclusions or re-examining real problems, the subject experiences difficulties, this shows that Subject S20's mathematical problem-solving and critical thinking abilities still experience difficulties and an inability to understand mathematical problems, although there are still shortcomings, but seen from the cumulative value of the subject's test, it can be concluded that in solving mathematical problems, Subject S20 can be said to have high mathematical problem-solving and critical thinking abilities.

As for the Analysis of Answers to the Level of Ability of Mathematical Problem Solving and Critical Thinking of Students in the Medium Category

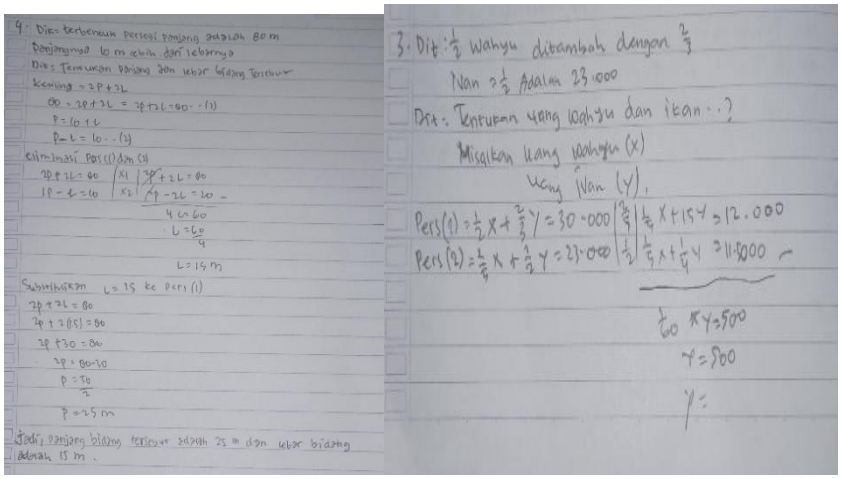


Figure 3. Analysis of Medium Level Answers

Based on the explanation of the interview excerpt, Subject S14 has a response and includes at least one response from the validated indicators, but when explaining about making conclusions or re-examining real problems, the subject experiences difficulties. This shows that Subject S14's mathematical problem-solving and critical thinking skills still experience difficulties and an inability to understand mathematical problems. Although he still has shortcomings, it can be concluded from the cumulative test scores of the subject that in solving mathematical problems, Subject S14 can be said to have moderate mathematical problem-solving and critical thinking skills.

As for the Analysis of Answers to the Level of Ability of Mathematical Problem Solving and Critical Thinking of Low Category Students

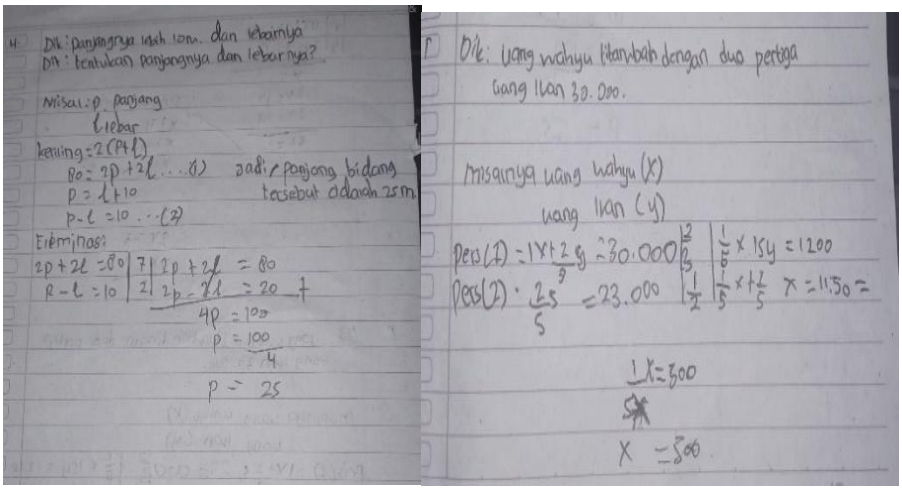


Figure 4. Low Level Answer Analysis

Based on the explanation of the interview excerpt, Subject S16 has a response and includes at least one response from the validated indicators, but when explaining about making conclusions or re-examining real problems, the subject experiences difficulties, this shows that Subject S16's mathematical problem-solving and critical thinking abilities still experience difficulties and inability to understand mathematical problems, although they still have shortcomings, but seen from the cumulative value of

the subject's test, it can be concluded that in solving mathematical problems, Subject S16 can be said to have low mathematical problem-solving and critical thinking abilities**.**

The description of students' mathematical problem solving abilities can be seen in the following table.

Table 1. Average Score of Students' Mathematical Problem Solving Ability for each Indicator

No	Indicators	Average Score of Mathematical Problem Solving Ability
1	Understand and explore the problem	77,6
2	Make a resolution plan	78,6
3	Implement the resolution plan	67,2
4	Recheck	35,9

Based on table 1, the comparison of indicator achievements obtained from the results of data analysis on each indicator provides an overview of the level of students' problem-solving knowledge which can be seen from the results of the average comparison of the four problem-solving ability indicators which can be described in the following diagram:

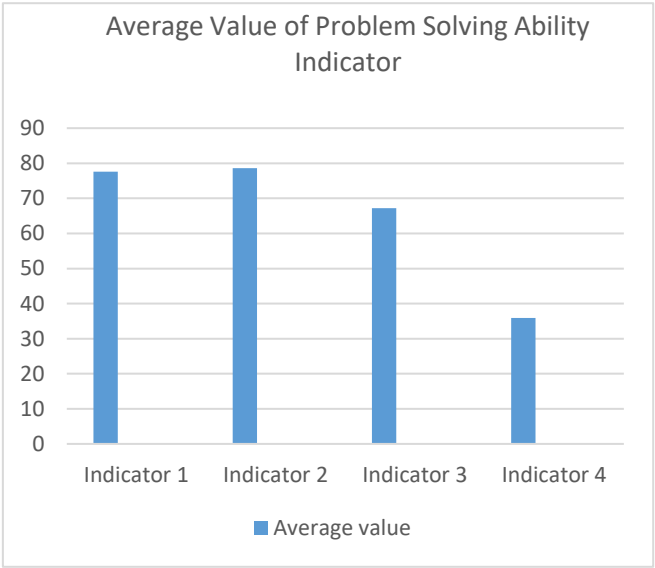


Figure 5. Level of Mathematical Problem Solving Ability Based on the Four Indicators

Figure 5 shows that the average value of the four indicators of mathematical problem solving is 65, indicating that the research subject students' mathematical problem-solving abilities are moderate, with the lowest indicator being re-checking in solving problems, followed by According to the statistics, students' understanding and exploring abilities should be greater than their planning abilities, but they don't write down what they know and are asked, resulting in a poor evaluation score. These statistics suggest that researchers should enhance students' mathematical problem-solving skills, particularly in the lowest indication, re-checking.

Analysis of Data from Students' Critical Thinking Ability Test Results

The results obtained from the data on students' critical thinking skills were analyzed based on the indicators. The results obtained from the data on students' critical thinking skills were analyzed based on their indicators. From the description of the achievement of the four indicators, it can be described by the distribution of students' abilities in critical thinking skills through the average score of the critical thinking skills test that has been carried out and analyzed. The description of students' critical thinking skills can be seen in the following table.

Table 2 Average score of students' critical thinking skills for each indicator

No	Indicators	Mean Critical Thinking Skills Score
1	Understanding and Analyzing Problems	71
2	Synthesizing Problems	78
3	Solving Problems	80
4	Making Conclusions	39,6

Based on table 2, the comparison of achievements obtained from the results of data analysis on each indicator provides an overview of the level of students' critical thinking knowledge which can be seen from the results of the average comparison of the three indicators of critical thinking ability which can be described in the following diagram.

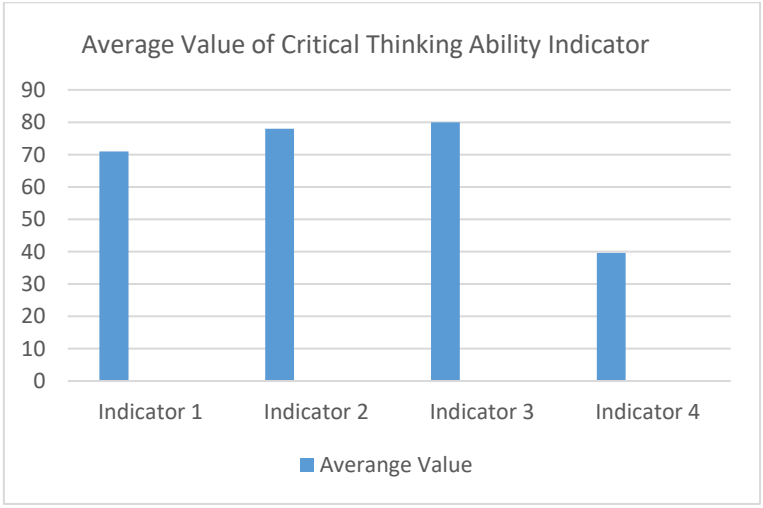


Figure 6. Level of Critical Thinking Ability Based on the Four Indicators

According to the four indicators, the average value of the four critical thinking indicators is 66.92, indicating that the research subject students' critical thinking ability is moderate and that the lowest indicator is making conclusions, followed by understanding and analyzing problems, and synthesizing p. However, because the average student ability is greater in indicators 2 and 3, it may be assumed that the student's skill is high in the first indication, but it was not authored by the student. Students will find it difficult to rewrite information from each challenge.

Discussion

Using mathematical problem-solving and critical thinking indicators, the researcher will uncover and evaluate field conversation. Through chosen interviews, the mathematical problem-solving and critical-thinking abilities exam results will be analyzed. The study of 24 students found that more than 70% of students had low mathematical problem-solving skills, which made it harder for them to understand and explore problems. This was because students tended to memorize the teacher's material and didn't fully understand the definition given. Students find it difficult to apply their thinking to solve mathematical problems that require simplifying real-life situations (Fauzia, 2018). They already assume math is only calculating without considering how it may make life easier.

This research supports idea (Polya, 1973) that pupils with poor mathematical problem-solving skills don't follow one of the four processes. Many students are less exact in solving issues, indicating that they have not completed all the problem-solving procedures to find a question-appropriate answer. (Hidayat, 2012) agree that pupils with limited mathematical problem-solving skills cannot grasp the issue, create a solution plan, and test it. Thus, pupils without problem-solving skills lack planning and evaluative capabilities. According to the study, over 70% of pupils have inadequate problem-solving skills in planning, executing, and rechecking. Some students struggle to get critical information from challenges at the start of the solution process. Students have trouble answering narrative problems, particularly those linked to daily life, since they have trouble "understanding and exploring problems" in arithmetic (Andayani, F., & Lathifah, 2019). Students will struggle to solve an issue if they cannot grasp and investigate it. According to (Siagian, M. D., & Sembiring, 2018) , pupils' critical thinking abilities are less sensitive due to a lack of responsiveness and a propensity to remember rather than comprehend.

This demonstrates that pupils concentrate on the instructor without underestimating, criticizing, or communicating what they say. The research found that over 70% of pupils had inadequate mathematical problem-solving skills and over 60% had low critical thinking skills, making them less competent to express genuine ideas in mathematics (Apriani. E, 2017).Some pupils were unable to reread the problem or follow the solution flow at the start of the solving procedure. Students have trouble solving narrative problems, particularly those relating to daily life, due to their difficulties in comprehending and analyzing mathematical problem-solving abilities and critical thinking. Students will struggle to answer questions if they can't discover and grasp the material. Reflective learning and trial findings from two Class VIII-A SMP PGRI 4 Medan meetings will be studied in the research. According to the research, kids had trouble responding to questions. This research aims to assist children who have limited mathematics problem-solving and critical thinking skills and struggle to answer all questions. No

mathematical problem-solving and critical thinking indications match. Students' replies only include what is known in the questions and cannot be completed correctly.

D. Conclusion

Based on the results of the analysis, research findings, and discussion of the research that has been explained after learning with a problem-based learning model, it is concluded that the mathematical problem-solving and critical thinking abilities and difficulties experienced by students are Students' mathematical problem-solving abilities on the material of two-variable linear equation systems in students are obtained such that the lowest achievement value is in the indicator of re-checking, then the indicator of implementing the settlement plan. Then seen from the average achievement value of all indicators carried out through the students' mathematical problem-solving ability test, it is included in the moderate category. Students' critical thinking abilities on the material of two-variable linear equation systems are obtained, and the lowest achievement value is in the indicator of making conclusions. The average achievement value of all indicators from the students' mathematical problem-solving ability test falls into the moderate category.

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