Perpendicular : Journal of Mathematics Education and Learning
Vol. 1 No. 1 2025, 21-30
Publisher: CV. Doki Course and Training

STUDENTS' MATHEMATICAL PROBLEM-SOLVING ABILITIES IN ALGEBRAIC EXPRESSIONS AT SMP NEGERI 48 PALEMBANG

Sadam Husen[1*], Jumroh[1]
Universitas PGRI Palembang[1]
Email : adamshaowalanz@gmail.com

ARTICLE INFO

Article History
Received : February 13, 2025
Revised : March 30, 2025
Accepted : March 31, 2025

Keywords
Mathematical problem-solving
Algebraic expressions

ABSTRACT

This study aims to assess the mathematical problem-solving abilities of students at SMP Negeri 48 Palembang in the topic of algebraic expressions. The research sample was selected randomly, consisting of 25 students. Data collection was conducted using essay-format test questions. The research employed a quantitative descriptive method. Based on data analysis and discussion, it can be concluded that students' mathematical problem-solving abilities are categorized as moderate, with an average score of 67.90. The students' abilities in solving problems based on specific indicators are as follows: understanding the problem (74.33), planning the solution (74.67), executing the plan (65.00), and interpreting the results (59.00).

ABSTRAK

Penelitian ini bertujuan untuk mengetahui kemampuan pemecahan masalah matematis peserta didik di SMP Negeri 48 Palembang, pada materi bentuk aljabar. Sampel penelitian ini diambil secara acak dengan jumlah peserta didik sebanyak 25 orang. Teknik pengumpulan data menggunakan soal tes berbentuk uraian. Metode yang digunakan dalam penelitian ini adalah metode deskriptif kuantitatif. Dari hasil analisis data dan pembahasan maka dapat disimpulkan bahwa kemampuan pemecahan masalah matematis peserta didik dikategorikan sedang dengan rata- rata 67,90. Kemampuan peserta didik dalam menyelesaikan soal pada indikator memahami masalah sebesar 74,33, pada indikator merencanakan penyelesaian sebesar 74,67, pada indikator melaksanakan rencana sebesar 65,00 dan pada indikator menafsirkan hasil sebesar 59,00.

Introduction

The progress of a nation is closely linked to its educational system, as education plays a crucial role in technological development. Formal education institutions, particularly schools, systematically design various learning environments that provide students with opportunities to engage in educational activities, enabling them to gain meaningful learning experiences. Among the subjects taught, mathematics holds a significant place in the curriculum.

As a discipline, mathematics fosters logical and systematic thinking. It enhances reasoning and problem-solving skills, contributing to various fields, including the workforce, science, and technology (Kossybayeva et al., 2022; Nilimaa, 2023; Sitopu et al., 2024). This statement is also endorsed by the government of the Republic of Indonesia. The significance of mathematics education is further regulated by the Indonesian government through Ministerial Regulation of the National Education Minister (Permendiknas) No. 22 of 2006. This regulation stipulates that mathematics education aims to equip students with the ability to (1) understand mathematical concepts, apply them appropriately, and establish connections between different concepts for effective problem-solving; (2) utilize reasoning to identify patterns, construct proofs, and articulate mathematical ideas; (3) develop problem-solving skills, which encompass understanding a problem, formulating a mathematical model, solving the model, and interpreting the results; and (4) communicate findings using symbols, tables, diagrams, or other media to clarify a given situation or problem.

These objectives clearly emphasize problem-solving as a fundamental goal of mathematics instruction. In practice, students frequently encounter mathematical problems related to the subject matter. However, difficulties arise due to a lack of familiarity with solving such problems, which often leads to challenges in developing problem-solving skills. Mathematical problem-solving is regarded as a core competency that students must acquire, as it is considered the heart of mathematics (Cahya & Juandi, 2021; Faulkner et al., 2023; Ida et al., 2021).

Mathematical problem-solving ability is strongly interconnected with mathematics, not only for those specializing in the field but also for individuals applying it in other disciplines and real-life situations. The primary goal of problem-solving in mathematics is to enhance students' willingness to improve their problem-solving skills and to increase their awareness of problem-solving strategies. According to (Sari et al., 2021; Ukobizaba et al., 2021), based on these objectives, problem-solving skills are one of the essential competencies that every student must develop, making them a central focus of mathematics education. Similarly, (Shanta & Wells, 2022) emphasizes that mathematical problem-solving ability is a fundamental skill that every student should possess, as it constitutes the core objective of mathematics instruction.

According to Susanto (Shanta & Wells, 2022), problem-solving is a crucial activity in mathematics education, as its objectives are closely related to real-life applications. Similarly, Polya (Daulay & Ruhaimah, 2019) defines mathematical problem-solving as an effort to find a solution to a difficulty in order to achieve a

goal that cannot be immediately attained. Polya further elaborates that mathematical problem-solving involves the ability to identify known and required elements, assess the sufficiency of information, construct and develop mathematical models, select and implement solution strategies, explain the reasoning behind the solution, and verify its accuracy (Savitri et al., 2021). Based on these expert perspectives, it can be concluded that problem-solving is an essential process in addressing any given problem by seeking an appropriate solution.

Insights from mathematics teachers at SMP Negeri 48 Palembang indicate that students generally struggle with problem-solving tasks. A student's proficiency in mathematical problem-solving is determined by their ability to meet all required indicators, which include (1) understanding the problem, (2) planning a solution, (3) executing the plan, and (4) interpreting the results. These indicators serve as essential guidelines to help students tackle mathematical challenges. Nevertheless, errors frequently occur when students attempt to solve mathematical problems.

Previous research has shown that problem-solving abilities differ across various stages. Many students exhibit a moderate level of understanding the problem, while a significant portion struggles with planning a solution. Similarly, a considerable number demonstrate moderate proficiency in executing the plan, whereas only a small fraction effectively reviews their results, placing them in the low category (Rahayu et al., 2024; Rahayuningsih et al., 2021).

SMP Negeri 48 Palembang is one of the public schools located in an urban-suburban fringe where students come from diverse socioeconomic backgrounds. Teachers have noted students' difficulties in solving non-routine mathematical problems. The curriculum implementation still relies heavily on procedural learning, which impacts students' strategic thinking and interpretation in mathematical contexts. These conditions make the school a relevant site for studying mathematical problem-solving.

Difficulties in solving mathematical problems often arise from unfamiliar question formats, causing confusion in identifying given information and determining the required solution. Additionally, the absence of a clear problem-solving strategy further complicates the process (Rusvi, 2024). Consequently, many students are unable to solve mathematical problems effectively. Considering these challenges, this study aims to assess students' mathematical problem-solving abilities in the topic of algebraic expressions at SMP Negeri 48 Palembang.

Method

This study employs a quantitative descriptive research approach aimed at assessing students' mathematical problem-solving abilities in the topic of algebraic expressions. The research subjects consist of 25 seventh-grade students from class VII.6 at SMP Negeri 48 Palembang during the second semester of the 2023/2024 academic year. Data collection was conducted through a test, which was administered on November 18, 2024. The research instrument consisted of mathematical problem-solving test questions focused on four key indicators: (1) understanding the problem, (2) planning a solution, (3) executing the plan, and (4) interpreting the results.

The research procedure involved several stages. The planning stage focused on preparing a test blueprint, test items, and scoring guidelines aligned with the problem-solving ability indicators. An example of the test questions used in this study is presented in Figure 1. Content validity was established through expert review by two mathematics educators. The instrument was piloted in another class with similar characteristics, and the reliability coefficient (Cronbach's Alpha) was 0.78.

1. Sekarang umur seorang adik 5 tahun kurangnya dari umur kakak. 5 tahun kemudian jumlah umur kakak dan adik menjadi 35 tahun.
    a. Tuliskan apa yang diketahui, dan ditanya
    b. Tentukan masing- masing umur kakak dan adik!
2. Harga 3 buah buku dan 5 pensil adalah Rp. 42.000. jika harga sebuah buku adalah 3 kali harga sebuah pensil.Tentukan harga masing- masing buku dan pensil!
3. Suatu kolam renang berbentuk persegi panjang memiliki lebar 7 kurangnya dari panjangnya dan kelilingnya 86m. Tentukan panjang dan lebarnya
4. Jumlah dua bilangan adalah 32 dan selisihnya 4. Jika bilangan 1 adalah x dan bilanga ke 2 adalah y. Tentukan dua bilangan tersebut !
5. Andi berbelanja ketoko buku, ia membeli 4 buah buku tulis dan 1 buah pensil. Untuk itu andi harus membayar sejumlah Rp. 5.600. di toko buku yang sama, budi membeli 5 buah buku tulis dan 3 buah pensil, jumlah uang yang harus dibayar Budi sebesar Rp. 8.400. Buatlah model matematika dari permasalahan tersebut!

Figure 1. The problem-solving test

In the implementation stage, students were seated according to a designated arrangement, and the researcher provided instructions on how to answer the questions before distributing the test and answer sheets for students to

complete. The data collection stage involved evaluating, scoring, and analyzing student responses based on the established scoring rubric for problem-solving skills. Finally, in the data analysis stage, the collected scores were entered into a score table, categorized accordingly, and processed using Excel to compute mean scores, maximum and minimum scores, mode, median, and standard deviation, providing a comprehensive overview of students' mathematical problem-solving abilities. After completing all calculations, the researcher analyzed the findings to determine students' problem-solving proficiency in the algebraic expressions topic.

After calculating each student's score and recording the results in a calculation table, the overall average score was determined to classify students based on their performance. The percentage scores were then categorized into three qualification levels: high, moderate, and low. This classification aimed to provide a clear understanding of the distribution of students' problem-solving abilities.

Table 1
Categories of Mathematical Problem-solving Ability

Interval	Category
$77,5 < P \leq 100$	High
$58,3 < P \leq 77,5$	Moderate
$0 < P \leq 58,3$	Low

Results and Discussion

This study was conducted to assess the mathematical problem-solving abilities of seventh-grade students in solving algebraic expression problems in mathematics. The test administered was a written essay-based assessment consisting of five questions. The test results can be seen in Table 2.

Table 2
Descriptive Statistics of Students' Mathematical Problem-solving Abilities

Statistic	Score
Number of students	25
Total Score	1697,64
Mean	67,90
Median	66,67
Modus	66,67
Standard Deviation	9,600
Max	90,48
Min	52,38

Based on Table 2, students' mathematical problem-solving abilities in solving algebraic expression problems have an average score of 67.90, which falls

into the moderate category. The distribution of students' achievement can be seen in Table 3.

Table 3
Test results of Mathematical Problem-solving Abilities of Seventh-Grade Students at SMP Negeri 48 Palembang.

No.	Achievement Percentage	Achievement Category	Frequency	Percentage
1	77,5 < P ≤ 100	High	4	16 %
2	58,3 < P ≤ 77,5	Moderate	18	72 %
3	0 < P ≤ 58,3	Low	3	12 %
	Total		25	100 %

The test results on mathematical problem-solving abilities presented in Table 3 indicate that 16% of students fall into the high category, 72% are in the moderate category, and 12% are classified as low. After obtaining the test results on students' mathematical problem-solving abilities, the following Table 4 provides a detailed analysis of students' responses based on each problem-solving ability aspect.

Table 4
Students' Mathematical Problem-solving Abilities

No.	Aspect	Score	Category
1	Understanding the problem	74,33	Moderate
2	Planning a solution	74,67	Moderate
3	Executing the plan	65,00	Moderate
4	Interpreting the results	59,00	Moderate

In this study, the researcher analyzed the mathematical problem-solving ability indicators, specifically understanding the problem. The findings indicate that students were generally able to comprehend the given problems, as reflected in a percentage score of 74.33, which falls into the moderate category. This suggests that most students were able to correctly identify the given information and the question in the problem. These results align with the study conducted by (Damayanti, 2022), which reported that the indicator of identifying known and asked elements, as well as the sufficiency of elements, achieved a percentage of 75.3%.

In aspect 1, students demonstrated their ability to understand the problem presented in the question. After reading the problem, students identified and provided the given information and the required solution. Based on data analysis, the results indicate that 64% of students answered correctly and accurately, while 16% provided correct but less precise responses. Additionally, 16% of students attempted to answer but made errors, and 4% did not provide any response. An

example of students' responses at the problem-understanding stage can be seen in Figure 2.

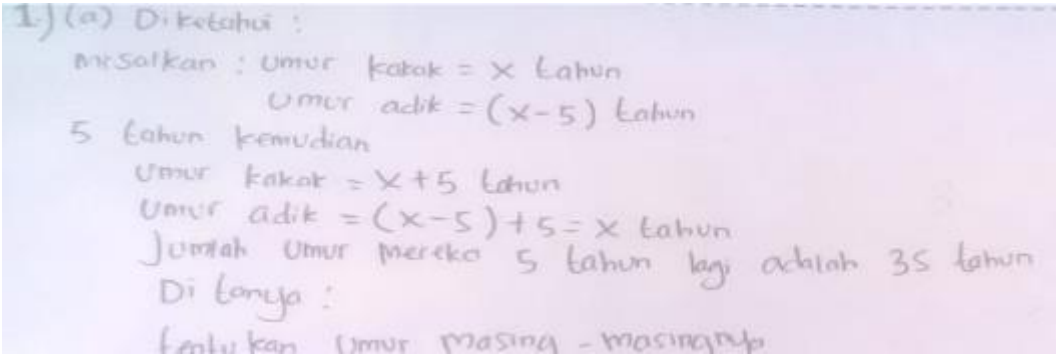

Figure 2. Example of a student's response in the aspect of understanding the problem

Next, the second aspect pertains to the problem-solving planning stage. In this aspect, 64% of students were able to develop an appropriate solution plan, while 20% attempted to create a plan but made errors, and 16% did not formulate a plan at all. Based on the test questions for this stage, students were expected to establish or write a mathematical relationship that represents the connection between the older sibling's age and the younger sibling's age. An example of a correct response can be seen in Figure 3.

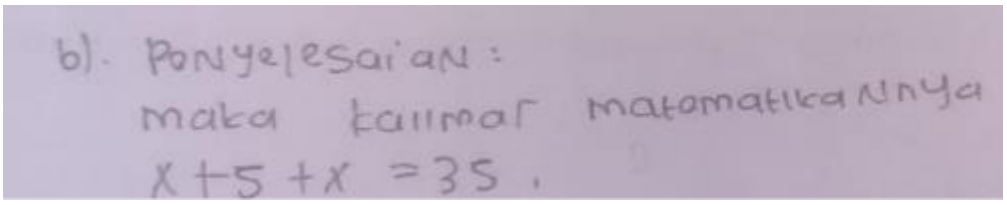

Figure 3. Example of a student's response in the aspect of planning a solution

In this study, the researcher analyzed students' mathematical problem-solving abilities, specifically focusing on the indicator of planning a solution. The findings indicate that students were generally able to develop a solution plan, as reflected in a percentage score of 74.67, which falls into the moderate category. This conclusion is supported by students' responses, where most participants successfully formulated a problem-solving plan. The indicator of executing the plan is used to assess how well students can carry out their solution strategies by applying appropriate concepts and formulas. Frequent practice, especially with non-routine problems, enhances students' problem-solving skills.

Based on students' responses for this aspect, 44% were able to execute the plan correctly and accurately, while 24% attempted the execution but were not

entirely accurate. Additionally, 16% made errors in carrying out the solution plan, and 16% did not provide an answer. In this study, the execution of the plan refers to students' ability to perform calculations to solve the mathematical model using the concepts and formulas they have understood. An example of students' responses for this indicator can be seen in Figure 4.

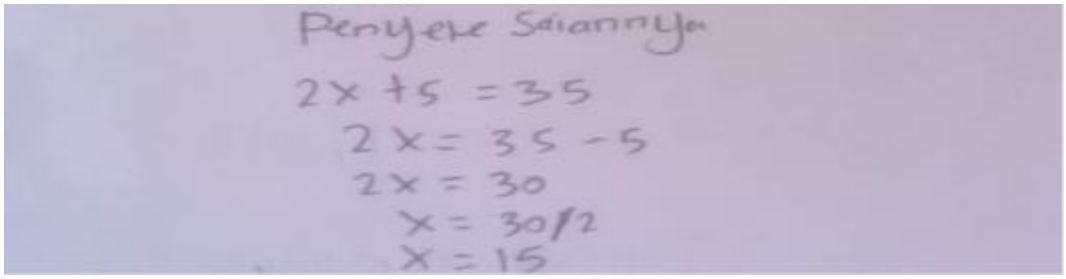

Figure 4. Example of a students' response in the aspect of execute the plan

The mathematical problem-solving ability in the indicator of interpreting results aims to assess how well students draw conclusions from the obtained solutions. The findings indicate that the average percentage for this indicator is 59.00, which falls into the moderate category. However, this result is higher than the findings of (Damayanti, 2022), who reported a score of 15.70 for the interpreting results indicator.

One of the challenges faced by students is their lack of familiarity with this step during classroom instruction. According to (Savitri et al., 2021) after obtaining a solution, students must apply it to the given problem to re-examine and verify whether the solution accurately addresses the problem. This aspect represents the lowest-scoring component in students' overall achievement. Based on students' responses, 32% were able to interpret the results correctly and accurately, while 8% attempted to interpret the results but were not entirely accurate. Additionally, 60% of students did not provide any response.

From Bloom's taxonomy perspective, interpreting results is part of higher-order thinking (evaluation level). Teachers may focus more on procedural skills (application level), resulting in lower achievement in reflective components. This study supports Polya's theory and underscores the need to reinforce each problem-solving stage in instructional practice. The moderate score in planning suggests students are capable of strategy development but need scaffolding. Frequent exposure to non-routine tasks and reflective practices will improve students' reasoning.

Conclusion

Based on the analysis conducted at SMP Negeri 48 Palembang, it can be concluded that students' mathematical problem-solving abilities have an average score of 67.90, which falls into the moderate category. The students' performance in solving problems is reflected in the following indicator scores: understanding the problem (74.33), planning a solution (74.67), executing the plan (65.00), and interpreting the results (59.00). Several recommendations can be made to further enhance their skills: teachers should place greater emphasis on helping students draw accurate conclusions from their solutions, students would benefit from frequent exposure to non-routine mathematical problems, and provide students with a dynamic learning experience, such as gamification and adaptive learning platforms may also enhance motivation and improve retention of problem-solving techniques.

Declarations

Author contribution. SH and J conceptualized and wrote the introduction. SH developed the research instrument. SJ and J conducted the instrument validation and pilot testing. SH collected the data. SH and J performed data analysis and co-wrote the article.

Funding statement. There was no funding for this research.

Conflict of interest. The authors declare no conflict of interest.

Additional information. No additional information is available for this paper.

References

Cahya, E., & Juandi, D. (2021). Students' critical thinking skills in solving mathematical problems; A systematic procedure of grounded theory study. *International Journal of Instruction*, *14*(4), 529–548.

Damayanti, N. (2022). Analisis kemampuan pemecahan masalah matematis siswa SMA pada materi barisan dan deret geometri. *Mosharafa: Jurnal Pendidikan Matematika*, *11*(1), 107–118.

Daulay, K. R., & Ruhaimah, I. (2019). Polya theory to improve problem-solving skills. *Journal of Physics: Conference Series*, *1188*(1), 12070.

Faulkner, F., Breen, C., Prendergast, M., & Carr, M. (2023). Profiling mathematical procedural and problem-solving skills of undergraduate students following a new mathematics curriculum. *International Journal of Mathematical Education in Science and Technology*, *54*(2), 220–249.

Ida, S., Aziz, R., & Irawan, W. H. (2021). Critical and creative thinking skills to solving math story problems in elementary school students. *Jurnal Tatsqif*, *19*(2), 98–113.

Kossybayeva, U., Shaldykova, B., Akhmanova, D., & Kulanina, S. (2022). Improving teaching in different disciplines of natural science and mathematics with innovative technologies. *Education and Information Technologies*, *27*(6), 7869–7891.

Nilimaa, J. (2023). New examination approach for real-world creativity and problem-solving skills in mathematics. *Trends in Higher Education*, *2*(3), 477–495.

Rahayu, S., Cahyani, R. E., Herlina, Y., & Wahyuni, R. (2024). Analysis of high school students' mathematical problem-solving abilities on matrix content. *Jurnal Inovasi Pembelajaran Matematika: PowerMathEdu*, *3*(2), 209–224.

Rahayuningsih, S., Sirajuddin, S., & Nasrun, N. (2021). Cognitive flexibility: Exploring students' problem-solving in elementary school mathematics learning. *Journal of Research and Advances in Mathematics Education*, *6*(1), 59–70.

Rusvi, A. N. (2024). Analysis of problem-solving abilities based on student proficiency levels in d phase. *DIDAKTIKA: Jurnal Pemikiran Pendidikan*, *30*(2), 173–190.

Sari, N. K., Budiarto, M. T., & Rozhana, K. M. (2021). Students' digital thinking skills in solving mathematics problems. *1st International Conference on Mathematics and Mathematics Education (ICMMEd 2020)*, 282–290.

Savitri, E. N., Amalia, A. V, Prabowo, S. A., Rahmadani, O. E. P., & Kholidah, A. (2021). The effectiveness of real science mask with QR code on students' problem-solving skills and scientific literacy. *Jurnal Pendidikan IPA Indonesia*, *10*(2), 209–219.

Shanta, S., & Wells, J. G. (2022). T/E design based learning: assessing student critical thinking and problem solving abilities. *International Journal of Technology and Design Education*, *32*(1), 267–285.

Sitopu, J. W., Khairani, M., Roza, M., Judijanto, L., & Aslan, A. (2024). The importance of integrating mathematical literacy in the primary education curriculum: A literature review. *International Journal of Teaching and Learning*, *2*(1), 121–134.

Ukobizaba, F., Nizeyimana, G., & Mukuka, A. (2021). Assessment strategies for enhancing students' mathematical problem-solving skills: A review of literature. *Eurasia Journal of Mathematics, Science and Technology Education*, *17*(3).