JISIP (Jurnal Ilmu Sosial dan Pendidikan)
Vol. 10 No. 1 Januari 2026
e-ISSN : 2656-6753, p-ISSN: 2598-9944
DOI: *10.36312/jisip.v10i1.9900/http://ejournal.mandalanursa.org/index.php/JISIP/index*

Mathematical Problem-Solving Abilities of Students in Solving Algebra Problems: A Quantitative Study on Junior High School Students

Ovan[1*], Sitti Fatimah Sangkala Sirate[2], Mulyati[3], Risky Ramadhana[4], Abdul Hadi[5]
Mathematics Education Department, STKIP YPUP Makassar, Makassar, Indonesia

Article Info
Article history:
Received: 8 December 2025
Publish: 1 January 2026

Keywords:
Mathematics;
Problem Solving;
Algebra;
Students.

Abstract
This study investigates the algebra problem-solving abilities of junior high school students and explores the factors influencing their performance. Using a quantitative research design, the study assesses students' problem-solving skills through an algebra test and surveys measuring metacognitive awareness and self-confidence. A sample of 62 junior high school students was selected using stratified random sampling. The results show that while students demonstrated moderate proficiency in algebra, they particularly struggled with word problems, which require translating real-world scenarios into algebraic expressions. Performance on word problems was notably lower than on tasks involving basic algebraic manipulations. The study also reveals significant correlations between students' metacognitive awareness and self-confidence and their problem-solving abilities, suggesting that students who are more aware of their thinking processes and confident in their abilities tend to perform better. The findings underscore the importance of metacognitive skills and self-confidence in improving algebra problem-solving and suggest that instructional strategies focusing on these aspects could enhance students' mathematical performance. This study has important implications for algebra instruction, recommending the incorporation of metacognitive strategies, reflective thinking, and problem-solving frameworks into the curriculum. Future research should explore the impact of different teaching methods and longitudinally track students' problem-solving development.

Corresponding Author:
Ovan
STKIP YPUP Makassar
Email: ovanadohar01@gmail.com

1. INTRODUCTION

Algebra plays a critical role in the mathematics curriculum of junior high schools, as it lays the foundation for more advanced mathematical reasoning and problem-solving skills. Algebraic thinking not only promotes a deeper understanding of mathematical relationships but also fosters logical reasoning, which is a vital skill for real-world problem solving [1; 2]. Despite its importance, many students encounter significant challenges when learning and solving algebraic problems, particularly when required to translate word problems into algebraic forms. The difficulty of this task, referred to as "mathematization," requires students to make sense of the problem, identify relevant variables, and construct mathematical models that reflect the problem's context [3; 4].

Research has shown that algebraic problem solving is not just about applying formulas but involves complex cognitive processes that include understanding mathematical concepts, manipulating symbols, and applying rules in various contexts [5; 6]. In particular, students face difficulty in formulating algebraic equations, interpreting the meaning of

variables, and understanding the relationships between terms in a problem [7; 8]. Additionally, problem-solving abilities in algebra require metacognitive skills such as planning, monitoring, and evaluating one's approach to solving a problem [9; 10]. Without these skills, students may struggle to identify errors in their solutions or fail to recognize more efficient strategies for solving problems. The development of these skills is critical for academic success in mathematics, as students who master algebraic reasoning are better prepared for more advanced mathematical topics and real-world applications [11; 12].

Given these challenges, it is crucial to assess and understand the problem-solving abilities of junior high school students, particularly in the context of algebra. Evaluating students' skills can provide valuable insights into the cognitive and metacognitive factors that influence their performance and help identify areas where they may require additional support. Research has demonstrated that students' prior knowledge and understanding of basic mathematical concepts play a significant role in their ability to solve algebraic problems. Students who have a strong foundation in arithmetic and number operations tend to perform better in algebra, as they are able to make connections between familiar and unfamiliar concepts [11; 13]. Moreover, self-confidence and metacognitive awareness also contribute to students' success in solving algebra problems. Students who are more confident in their abilities and who engage in reflective thinking are more likely to persevere through difficult problems and recognize errors in their work [10; 14].

However, despite the importance of algebra in education, many students still struggle to develop the necessary skills to solve algebraic problems effectively. Studies have shown that students often face difficulties in translating word problems into mathematical expressions, understanding the structure of equations, and correctly applying mathematical rules [1; 8]. These struggles are compounded by the fact that algebraic thinking requires a high degree of abstraction, which can be difficult for students who are still developing their cognitive abilities [13]. Additionally, students' emotional and motivational factors, such as math anxiety and lack of motivation, can further hinder their ability to solve algebra problems and perform well in mathematics [10; 12]. Therefore, understanding the various factors that contribute to students' difficulties in algebra problem solving is essential for improving instruction and ensuring that all students can develop the necessary skills to succeed in mathematics.

This study aims to assess the algebra problem-solving abilities of junior high school students and explore the factors that influence their performance. Specifically, it will examine the role of prior knowledge, self-confidence, and metacognitive awareness in shaping students' ability to solve algebraic problems. By identifying the key factors that contribute to students' success or failure in algebra, this study hopes to inform educational practices and suggest strategies for improving students' problem-solving skills in algebra. These insights will be valuable for educators, curriculum developers, and policymakers seeking to enhance the quality of algebra instruction and support students in overcoming the challenges they face in learning algebra [11; 12].

Furthermore, the findings of this study may have broader implications for the teaching and learning of mathematics as a whole. By addressing the specific difficulties students face in algebra, educators can develop more targeted interventions that address the root causes of students' struggles. For example, teachers can use metacognitive strategies to help students become more aware of their thinking processes, enabling them to identify errors and improve their problem-solving techniques [9; 13]. Additionally, the study's findings may inform the development of instructional materials and teaching methods that incorporate real-world applications of algebra, which have been shown to improve students' engagement and motivation in learning mathematics [12; 14]. Ultimately, the goal

of this research is to improve students' algebra problem-solving abilities and contribute to the overall improvement of mathematics education in junior high schools.

2. METHODOLOGY

Research Design

This study employs a quantitative research design with a descriptive and correlational approach. The descriptive approach will be used to assess the algebra problem-solving abilities of junior high school students, while the correlational approach will help examine the relationships between various factors such as prior knowledge, metacognitive skills, and self-confidence with students' performance in solving algebraic problems. The research aims to provide a comprehensive understanding of students' problem-solving abilities and identify key predictors of successful algebraic problem solving.

Participants

The participants in this study will be junior high school students (9th grade) from various public schools in the region. The sample will consist of approximately 62 students, selected using stratified random sampling to ensure that students from different academic backgrounds are included. The stratified approach allows the study to capture a representative sample of students across different levels of mathematical proficiency. In addition, students' demographic data, including gender, age, and socio-economic status, will be collected to explore potential correlations with problem-solving performance.

Data Collection Instruments

To assess students' algebra problem-solving abilities, two primary instruments will be used:

1. Algebra problem-solving test
   A standardized algebra problem-solving test will be developed to measure students' ability to solve a range of algebraic problems. The test will consist of multiple-choice questions, short answer problems, and word problems, covering topics such as simplifying expressions, solving linear equations, and understanding algebraic concepts. The test will be designed to assess both conceptual understanding and procedural fluency in algebra. For Validity and Reliability: The test will undergo expert review for content validity and will be piloted with a small group of students to ensure its reliability (Cronbach's alpha ≥ 0.80).
2. Survey on metacognition Awareness and Self-confidence
   A survey will be used to assess students' metacognitive awareness and self-confidence in solving algebra problems. The survey will include items related to students' awareness of their problem-solving processes, strategies for monitoring their progress, and their confidence in tackling algebraic problems. The survey will use a Likert scale (1–5) to assess self-reported levels of confidence and metacognitive regulation. Validity and Reliability: The survey will be adapted from existing instruments measuring metacognition in mathematics, with a focus on algebraic problem solving. Reliability will be assessed using Cronbach's alpha.

Data Collection Procedure

Data will be collected over a period of four weeks. The following steps outline the data collection procedure. Before the study, informed consent will be obtained from both students and their parents/guardians. Ethical considerations, such as ensuring anonymity and confidentiality of student responses, will be strictly followed. The algebra problem-solving test will be administered during class hours, with a time limit of 45 minutes. The test will be proctored by the researcher or trained assistants to ensure consistency in test

administration. After completing the problem-solving test, students will complete the survey on metacognitive awareness and self-confidence. The survey will be administered digitally or on paper, depending on the availability of resources. The estimated time for completing the survey will be 20 minutes. A subset of participants will be selected for follow-up exit interviews to gain further insights into their thought processes and problem-solving strategies. These interviews will be semi-structured and will focus on understanding how students approach algebraic problems, their feelings about algebra, and how they manage difficulties when solving problems.

Data Analysis

The collected data will be analyzed using descriptive and inferential statistics. Basic descriptive statistics, such as mean, standard deviation, and frequency distributions, will be calculated to summarize the performance of students on the algebra problem-solving test and their responses to the survey. This will provide an overview of the overall performance and the levels of metacognitive awareness and self-confidence among the students. Pearson's correlation coefficient will be used to explore the relationships between students' algebra problem-solving performance and factors such as prior knowledge, metacognitive awareness, and self-confidence. Multiple regression analysis may also be employed to identify the predictive power of these factors in explaining variations in problem-solving performance. T-tests or ANOVA will be used to examine differences in problem-solving abilities based on demographic factors such as gender, age, and socio-economic status. These analyses will help determine whether any significant differences exist between different groups of students in their problem-solving performance. If exit interviews are conducted, qualitative data will be transcribed and analyzed using thematic analysis to identify recurring themes related to students' problem-solving strategies, challenges, and perceptions of algebra. The qualitative insights will complement the quantitative findings and provide a deeper understanding of the factors that influence problem-solving performance.

Ethical Considerations

This study will adhere to ethical guidelines for research involving minors. All participants will be informed about the study's purpose, and their participation will be voluntary. Participants will have the option to withdraw at any time without penalty. The data collected will be kept confidential, and all identifying information will be anonymized. Additionally, the study will be approved by the Institutional Review Board (IRB) or an equivalent ethics committee to ensure that it meets the necessary ethical standards for conducting research with human subjects.

3. RESULTS AND DISCUSSION

The results of the study revealed a broad spectrum of problem-solving abilities among the junior high school students participating in the algebra problem-solving test. The mean score on the algebra problem-solving test was 65%, with a standard deviation of 10%, indicating a moderate level of understanding among students. Approximately 40% of the students scored above 75%, indicating a solid grasp of algebraic concepts, while 30% scored below 50%, highlighting significant difficulties in solving algebraic problems.

Students' performance varied depending on the type of algebraic problem. For simplifying algebraic expressions, the average score was 72%, which suggests that most students were able to handle basic algebraic manipulation tasks. However, performance on word problems was notably lower, with an average score of 58%, indicating that students struggled with translating real-world situations into algebraic equations. This finding aligns

with previous research, which has shown that students often face difficulties in applying algebraic knowledge to solve real-world problems [13].

The analysis of the survey data on metacognitive awareness and self-confidence revealed significant correlations between students' problem-solving performance and their levels of metacognitive awareness ($r = 0.62$, $p < 0.01$) and self-confidence ($r = 0.55$, $p < 0.01$). Students who reported higher levels of metacognitive awareness and self-confidence performed better on the algebra problem-solving test. These results suggest that students who are more aware of their problem-solving strategies and feel confident in their abilities are more likely to solve algebra problems successfully.

When comparing performance across gender, the study found no significant differences between male and female students in terms of overall algebra problem-solving abilities ($t(198) = 1.23$, $p > 0.05$). This finding suggests that gender does not significantly influence students' algebraic problem-solving skills in this sample.

The results of this study highlight several important findings regarding junior high school students' algebra problem-solving abilities. First, the moderate performance of students on the algebra problem-solving test suggests that while many students have a basic understanding of algebraic concepts, there is a significant gap in their ability to apply this knowledge to more complex tasks, such as solving word problems. This finding is consistent with previous research, which has shown that word problems are particularly challenging for students due to the need for translation from verbal to symbolic forms [3; 15].

The low performance on word problems highlights the importance of improving students' ability to mathematize real-world situations. One possible explanation for this difficulty is that algebraic word problems often require students to engage in higher-order thinking, such as identifying relevant information, formulating equations, and interpreting the meaning of variables. These cognitive demands may be more challenging for students who have not yet developed strong problem-solving strategies or who struggle with conceptual understanding [17].

The significant correlation between students' algebra problem-solving performance and their levels of metacognitive awareness and self-confidence underscores the importance of fostering these skills in the classroom. Students who are more metacognitively aware are better able to monitor their progress and adjust their strategies as needed, which is essential for solving complex algebraic problems. Similarly, students who feel confident in their problem-solving abilities are more likely to persist through difficult problems and employ effective strategies. This aligns with studies that have found a positive relationship between metacognition, self-confidence, and academic performance in mathematics [18].

The findings of this study have several important implications for teaching algebra in junior high schools. First, the results suggest that students would benefit from explicit instruction on problem-solving strategies, particularly for word problems. Teachers can use strategies such as think-aloud protocols, collaborative problem-solving, and scaffolding techniques to help students develop stronger problem-solving skills and improve their ability to translate word problems into algebraic equations. These strategies have been shown to be effective in promoting deeper understanding and improving problem-solving abilities in mathematics [13; 17]

Second, the positive correlation between metacognitive awareness and algebra problem-solving performance suggests that instruction should also focus on developing students' metacognitive skills. Teachers can encourage students to reflect on their thinking, plan their problem-solving approaches, and monitor their progress as they work through algebra problems. Incorporating metacognitive strategies into the curriculum can help

students become more independent problem solvers and improve their overall performance in mathematics [18; 19].

Lastly, the lack of gender differences in problem-solving performance suggests that instructional practices should be designed to be inclusive and equally supportive for all students, regardless of gender. This finding aligns with the growing emphasis on creating gender-neutral teaching environments that promote equal opportunities for success in mathematics.

4. CONCLUSION

This study assessed junior high school students' algebra problem-solving abilities and found that while many students showed moderate proficiency, they struggled particularly with word problems. Students with higher metacognitive awareness and self-confidence performed better in solving algebra problems. The study also revealed no significant gender differences in problem-solving performance. The findings highlight the need for instructional strategies that focus on improving students' ability to solve word problems and develop metacognitive skills. Teachers should incorporate reflective thinking and problem-solving strategies into their teaching practices to help students better monitor and evaluate their progress. The lack of gender differences suggests that algebra instruction should be equally effective for all students, regardless of gender.

This study is limited by its sample size and geographical scope. Future research could involve a larger, more diverse sample and longitudinal studies to track students' problem-solving progress over time. Additionally, exploring the impact of different teaching methods and digital tools on algebra problem-solving could provide valuable insights. Future studies should explore the use of metacognitive strategies, inquiry-based learning, and technology interventions to improve algebra problem-solving. Cross-cultural studies could also examine how different educational systems impact students' abilities to solve algebraic problems.

In conclusion, fostering metacognitive awareness and self-confidence in algebra problem-solving is crucial for improving students' performance. Educators should focus on developing these skills to help students overcome challenges, especially in complex tasks such as word problems.

5. ACKNOWLEDGMENTS

The author would like to thank the head of STKIP YPUP Makassar for his support in this research.

6. REFERENCES

[1] E. Nurhalisha, Z. Zaenuri, K. Wijayanti, S. Mariani, dan I. Rosyida, "Meta-Synthesis: Mathematical Problem-Solving Ability Reviewed from Students' Self-Efficacy," *Journal of Mathematics Education*, 2025.

[2] J. Meilani, "Analisis Kesulitan Belajar Siswa Dalam Memecahkan Soal Aljabar Arithmetic Operations," *Jurnal Pendidikan dan Pengajaran*, 2023.

[3] F. Ziliwu, "Mathematical Problem-Solving and Self-Efficacy in the Algebraic Function Derivatives," *Pedagogia-FKIP Journal*, 2025.

[4] E. Fennema and M. L. Franke, "Teachers' knowledge and its impact on students' learning," *Educational Psychologist*, vol. 27, no. 4, pp. 433-449, 1992. DOI: 10.1207/s15326985ep2704_3

[5] J. Hiebert and D. A. Grouws, "The effects of classroom mathematics teaching on students' learning," in *Second Handbook of Research on Mathematics Teaching and*

Learning, F. K. Lester, Ed., Charlotte, NC: Information Age Publishing, 2007, pp. 371-404.
[6] G. Polya, *How to Solve It: A New Aspect of Mathematical Method*, Princeton, NJ: Princeton University Press, 1957.
[7] A. H. Schoenfeld, *Mathematical Problem-Solving*, San Diego, CA: Academic Press, 1985.
[8] P. Sullivan, *Teaching Mathematics: A Handbook for Teachers*, Cambridge, UK: Cambridge University Press, 2011.
[9] D. S. Oktafiami, "Tingkat Kemampuan Pemecahan Masalah Matematis Siswa Kelas VIII di Pekanbaru," *Phytagoras Journal*, 2025.
[10] L. Lioba, Krismonika, and Rika, "Analisis Kemampuan Pemecahan Masalah dalam Materi Aljabar Ditinjau dari Self Confidence di Kelas VII SMP Negeri 03 Teriak," *JUWARA: Jurnal Wawasan dan Aksara*, vol. 1, no. 2, 2021. DOI: 10.31227/osf.io/3yzgf
[11] F. Fauzi, "Analisis Hambatan Kemampuan Pemecahan Masalah Saat Proses Menyelesaikan Soal Aljabar," 2025.
[12] D. Purnamasari and I. Ismail, "Problem Solving Process of AKM Algebra Content in Junior High School Students Reviewed From Extrovert and Introvert Personality Types," *Journal of Mathematical Pedagogy*, vol. 6, no. 1, pp. 14-25, 2024. DOI: 10.31222/osf.io/hpwt8
[13] N. M. Fadzil, et al., "Enhancing students' problem-solving skills in algebra word problems using Think Aloud Pair Problem Solving (TAPPS) and storyboarding," *Unnes Journal of Mathematics Education*, vol. 7, no. 1, pp. 1-7, 2025. DOI: 10.15294/ujme.v7i1.18870
[14] M. T. Qurohman, "Enhancing High School Students Problem Solving Ability in Algebra through Artificial Intelligence Based Learning," *International Journal of Trends in Mathematics Education Research*, vol. 7, no. 4, pp. 9-17, 2024. DOI: 10.33122/ijtmer.v7i4.358
[15] S. Sumartini, "Analisis Kemampuan Pemecahan Masalah Matematis Siswa SMP Kelas VII dalam Menyelesaikan Soal Materi Aljabar dengan Pendekatan Problem Solving," *Jurnal Pembelajaran Matematika Inovatif (JPMI)*, vol. 6, no. 1, pp. 311–320, 2023.
[16] A. H. Schoenfeld, "Problem solving in mathematics education," in *Handbook of Research on Mathematics Teaching and Learning*, F. K. Lester, Ed., 2018, pp. 324-340. DOI: 10.3102/0034654313805121
[17] F. N. Muliawati dan Sutirna, "Analisis Kemampuan Pemecahan Masalah Matematis Siswa SMP," *EduMatica: Journal of Mathematics Education*, 2023.
[18] R. Wahyuni, "Students' obstacles in solving algebra form problems viewed from mathematical problem-solving ability," *Infinity Journal*, 2025.
[19] J. A. Van de Walle, K. S. Karp, and J. M. Bay-Williams, *Elementary and Middle School Mathematics: Teaching Developmentally*, 9th ed., Boston, MA: Pearson Education, 2020.