AXIOM : Jurnal Pendidikan dan Matematika
(2025) Volume 14, No. 1, Page 114-125
https://doi.org/10.30821/axiom.v14i1.18461

Algebraic thinking skills of madrasah tsanawiyah (MTs) students in solving algebraic problems

Mustain Bagus Daroini*, Subanji, Santi Irawati
Universitas Negeri Malang, East Java, Indonesia
E-mail: mustain.laros@gmail.com

Received: 10 December 2023 / Accepted: 15 March 2025 / Published Online: 30 June 2025

Abstract
Algebra is a fundamental topic in the mathematics curriculum at Madrasah Tsanawiyah (MTs), yet many students continue to face challenges in solving algebraic problems. This study aims to examine the algebraic thinking skills of eighth-grade students at MTs Unggulan PP Amanatul Ummah Surabaya, particularly through number-oriented and structure-oriented approaches. A descriptive qualitative method was employed, involving 61 students as participants. The instruments included an algebraic thinking test incorporating visual illustrations and in-depth interviews with six selected students representing high, medium, and low ability levels. The findings reveal that only high-ability students were able to effectively apply structure-oriented algebraic thinking. The majority of students demonstrated moderate-level skills, with primary difficulties in constructing mathematical models based on problem structures. These results underscore the importance of instructional strategies that cultivate students' structural reasoning in algebra. The study provides valuable insights for educators to design learning activities that support the development of students' algebraic thinking, and it serves as a reference for future research to explore targeted interventions aimed at enhancing algebraic problem-solving abilities in MTs students.

Keywords: Algebraic thinking, Madrasah tsanawiyah students, Number-oriented approach, Structure-oriented approach, Algebra problem solving

How to Cite: Daroini, M. B., Subanji, S., & Irawati, S. (2025). Algebraic thinking skills of madrasah tsanawiyah (MTs) students in solving algebraic problems. *AXIOM : Jurnal Pendidikan dan Matematika, 14(1)*, 114-125. https://doi.org/10.30821/axiom.v14i1.18461

Introduction

In the Indonesian education system, Madrasah Tsanawiyah (MTs) is an educational institution equivalent to junior high school. However, due to differences in their foundational purposes, the characteristics of MTs and junior high schools are not identical (Abdima, 2023) MTs operate under the guidance of the Ministry of Religious Affairs and incorporate Islamic characteristics, whereas junior high schools fall under the jurisdiction of the Ministry of Education, Culture, Research, and Technology (Muallif, 2023). Additionally, MTs have a greater number of subjects and longer study hours compared to junior high schools (SEO, 2023).

Mathematics is a mandatory subject for MTs students, aligning with the views of researchers who emphasize its importance at the junior high school/MTs level (Kamarullah, 2017; Priyanto & Agus, 2013; Siahaan et al., 2018; Zulfah, 2019). In accordance with this, the

Curriculum Implementation Guidelines for Madrasahs outlined in KMA 184 of 2019 classify mathematics as part of Group A, meaning its content and curriculum references are developed by the central government (K. A. R. Indonesia., 2019).

Students are expected to master mathematical symbols and expressions when learning mathematics (Amalliyah et al., 2022; Harini & Oka, 2016), a key component of the mathematics curriculum in MTs, focuses on mathematical symbols (Hardianti & Kurniasari, 2019; Krismanto, 2004; Napaphun, 2012). The mathematics curriculum in MTs includes the following subject areas, namely: numbers, algebra, geometry and measurement, and statistics and probability (K. P. Indonesia, 2006; Stacey, 2011).

Unlike Arithmetic, which deals solely with numbers, Algebra introduces letters as mathematical symbols, commonly referred to as variables. In Arithmetic, students work with numbers and their operations (addition, subtraction, multiplication, and division), whereas in Algebra, they must understand how letters function as variables representing unknown quantities (Alibali, 2005; Hidayanto et al., 2014). When solving Arithmetic problems, students can directly visualize numerical quantities, whereas in Algebra, variables replace numbers, making it more abstract (Widyawati et al., 2018).

Students frequently encounter contextual problems involving Algebra in their daily lives. These problems are presented in the form of story-based questions that reflect real-life experiences and connect to students' activities, either directly or indirectly, while integrating mathematical concepts (Anggraeni & Herdiman, 2018). Table 1 provides examples of contextual and non-contextual Algebra problems.

Table 1. Contextual and Non-Contextual Example

No.	Example Contextual Questions	Examples of non-Contextual Questions
1	Abdulloh has 45 marbles and 70 Lego blocks. He gives some of them to his younger brother. After giving them away, Abdulloh has 15 marbles and 30 Lego blocks remaining. Question: How many marbles and Lego blocks did Abdulloh give to his younger brother?	Equation: [45x + 70y - 15x - 30y = , ?]
2	The total price for 5 pairs of shoes and 10 pairs of sandals is Rp. 700,000. The price of a pair of shoes is 5 times the price of a pair of sandals. Question: Determine the cost of a pair of shoes and a pair of sandals.	Equations: [5x + 10y = 700,000] [x = 5y] Determine the value of (x) and (y)!

Teaching students how to think critically is one of the primary goals of mathematics education (Shadiq, 2014; Siahaan et al., 2018). The Ministry of Education and Culture, through Permendiknas No. 22 of 2006, mandates that all students—from elementary to senior high school—study mathematics, as it fosters logical, analytical, systematic, critical, and creative thinking, as well as collaboration skills (K.P.Indonesia, 2006; Subanji, 2011).

Algebraic thinking is a cognitive process that enhances mathematical reasoning by assigning meaning to Algebraic symbols and operations (Sukmawati, 2015). (Kieran, 2014) further defines Algebraic thinking as the ability to use various representations to solve quantitative problems through symbolic relationships (Sanit & Sulandra, 2019).

In contrast, Arithmetic thinking is primarily focused on numerical calculations and computational operations. (Hidayanto et al., 2014) describe Arithmetic thinking as a process centered on obtaining numerical answers through direct computation. At the elementary level, students engage with numbers and their operations, which they can easily visualize. However, at the secondary level, Algebra introduces variables—letters that replace numbers—making it more abstract and challenging to conceptualize (Widyawati et al., 2018). Due to these fundamental differences between Arithmetic and Algebra, students require distinct cognitive approaches when transitioning from one to the other.

Interviews conducted with mathematics teachers at MTs Unggulan PP Amanatul Ummah Surabaya on October 9, 2023, revealed that some eighth-grade students struggle with Algebraic problem-solving. Specifically, students frequently make errors when converting information into Algebraic expressions. This issue was further highlighted by the teacher's analysis of daily test scores on linear equations in two variables, which showed significant difficulties among students.

One effective strategy for enhancing students' Algebraic thinking is problem-based learning, where students engage with Algebraic concepts through structured problem-solving exercises. After completing these problems, teachers provide feedback, including explanations and corrective guidance, to help students refine their understanding. By actively involving students in Algebraic problem-solving, educators can foster deeper cognitive engagement and improve their ability to think Algebraically (Amalliyah et al., 2022; Kusumaningsih & Herman, 2018; Sanit & Sulandra, 2019).

(Widyawati et al., 2018) examined Algebraic thinking and found that eighth-grade students often struggle with writing mathematical expressions, constructing problem-solving models, and formulating conclusions when addressing word problems. Additionally, (Hardianti & Kurniasari, 2019) identified gender-based differences in Algebraic thinking among eighth-grade students. Their study revealed that male students tend to rely on trial-and-error methods, whereas female students prefer Algebraic approaches when determining unknown values in equations.

While previous studies have explored various aspects of Algebraic thinking, they primarily focus on problem-solving processes and cognitive approaches among eighth-grade students. However, there remains a gap in research regarding students' perspectives on Algebraic problems, particularly in relation to specific value-based reasoning or structural approaches in problem-solving. Addressing this gap, the present study aims to investigate the Algebraic thinking skills of students at MTs Unggulan PP Amanatul Ummah Surabaya in solving Algebraic problems.

Based on the discussion above, this study seeks to analyze how eighth-grade students at MTs Unggulan PP Amanatul Ummah Surabaya approach Algebraic problem-solving. It specifically focuses on four key aspects: students' cognitive processes in interpreting and solving algebraic problems, common errors that occur during the transition from arithmetic to algebra, the role of structural reasoning in shaping algebraic thinking, and effective teaching strategies that can enhance students' ability to think algebraically. By exploring these aspects, this research aims to provide insights into students' Algebraic reasoning patterns, identify challenges they face, and propose instructional methods to improve their understanding of Algebra.

Research Methods

Algebraic problems involve concepts related to Algebra, requiring students to identify and apply appropriate mathematical principles to solve them. As demonstrated in the contextual problem examples, students must develop a strong understanding of Algebraic concepts to effectively approach these problems. Consequently, acquiring Algebraic thinking skills is essential (Sanit & Sulandra, 2019) Algebraic thinking is a cognitive process that enhances mathematical reasoning by assigning meaning to Algebraic symbols and operations (Sukmawati, 2015). (Kieran, 2014) further defines Algebraic thinking as the ability to use various representations to solve quantitative problems through symbolic relationships. The indicators for the Algebraic Thinking Test in this study were adapted from (Lenz, 2022) and are presented in Table 2.

Table 2. Thinking Category

Thinking Category	Indicator	Code
Number-Oriented Approach	Students can state clear values in the problem (Focuses on specific values)	A1
	Students can deterimine values based on appropriate calculation procedures (Focuses on computational procedures)	A2
Structure-Oriented Approach	Students can transform problem information into mathematical examples (structural perspective)	R1
	Students recognize the "equal to" sign as a symbol of relationship (focuses on quantities)	R2
	Students can accurately and appropriately solve the given problems (focuses on using a structural perspective and quantities)	R3

This study employed a descriptive qualitative approach to analyze and interpret the broader meaning of the results (Creswell, 2012). Researchers explored and described the Algebraic thinking of MTs Unggulan PP Amanatul Ummah Surabaya students on October 9, 2023. The study involved 61 eighth-grade students, who were given four Algebraic Thinking Test items featuring illustrative images related to linear equations in two variables.

Data for this study were collected through Algebraic Thinking Tests and interviews with selected students. The interview subjects consisted of two high-ability students, two medium-ability students, and two low-ability students. To ensure the quality of the research instruments, the validity was tested across three aspects: content, construction, and language. The validation process involved a mathematics education lecturer from the State University of Malang and a mathematics teacher from MTs Unggulan PP Amanatul Ummah Surabaya. The validators confirmed the validity of the instruments, offering several suggestions for improvement. The final instrument achieved a validity coefficient of 3.86 on a scale of 1 to 5, indicating that it was valid and reliable for use.

The research was conducted in three stages. The preparation stage included designing the research framework, developing and validating the instruments, conducting seminars for feedback, revising instruments, securing research permits, and conducting a pilot test followed by data analysis and subject selection. In the implementation stage, the researchers administered the Algebraic Thinking Test, assessed student responses, analyzed the data, conducted interviews, and drew conclusions based on the students' problem-solving approaches. Finally, in the concluding stage, all findings were compiled and documented in a comprehensive research report.

Result

This study investigated the algebraic thinking skills of students at MTs Unggulan PP Amanatul Ummah in solving algebraic problems. The researchers focused on analyzing the components of algebraic thinking demonstrated by students when responding to problems presented through Algebraic Thinking Tests (TBA), which were designed using illustrative visual representations. The test consisted of four essay-based questions and was administered individually within a 90-minute timeframe. After the tests were completed, researchers collected, corrected, assessed, and summarized the students' responses to gain a comprehensive understanding of their algebraic thinking abilities. Furthermore, six students were selected for in-depth analysis based on their performance level: two high-ability students, two medium-ability students, and two low-ability students. Their responses were further analyzed and presented in visual formats to effectively illustrate the key findings of the research.

Algebraic Thinking Test Results

Based on the results of the Algebraic Thinking Test, researchers converted the data into statistical form, as shown in Table 3.

Table 3. Statistical Data of Students' Algebraic Thinking Tests

No	Statistics	Results
1	Highest score	100
2	Lowest Score	0
3	Mean	41,33
4	Median	37,50
5	Modus	16,67
6	Standard Deviation	30,26

Table 3 shows that the standard deviation is 30.26, which indicates the degree of variability in students' Algebraic thinking scores. Additionally, the mean score of 41.33 suggests that the overall level of Algebraic thinking among students at MTs Unggulan PP Amanatul Ummah Surabaya falls within the moderate category, as classified in Table 4.

Table 4. Categorization of Students' Algebraic Thinking Levels

Value Range	Algebraic Thinking Category	Number of Students	Average Algebra Ability	Percentage
71,59 – 100	High Capability	12	95,83	19,67
11,06 – 71,59	Medium Capability	39	38,37	63,93
0 – 11,06	Low Capability	10	1,39	16,39
Total		**61**		

Table 4 indicates that the majority of students (63.93%) exhibit moderate Algebraic thinking skills, while 19.67% demonstrate high capability, and 16.39% fall into the low capability category. These findings suggest that students' Algebraic thinking skills are generally below average, with most students performing at a moderate level.

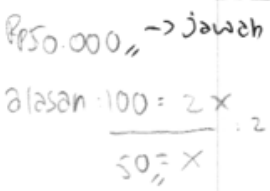
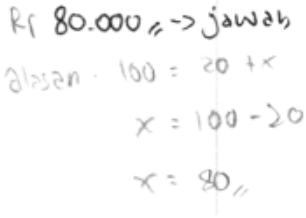
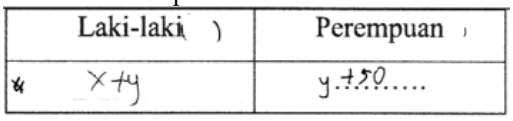
Description of Algebraic Thinking in High-Ability Students

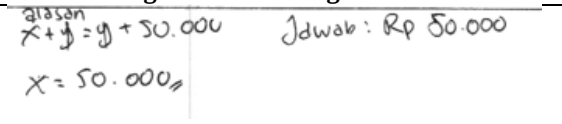
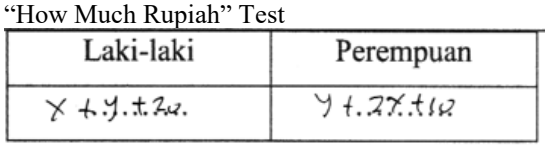
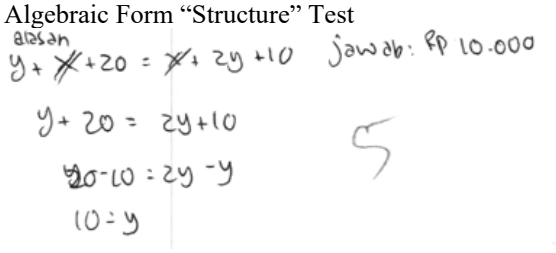
High-ability students (SKT) demonstrated proficiency in solving all the algebraic thinking test items accurately and effectively. SKT carefully read and comprehended the question material, as evidenced by the following interview excerpt.

P : *When you received this question, what was the first thing you did?*
SKT : *I read the information in the question and first tried to understand what was being asked.*
P : *What did you understand from each item presented?*
SKT : *I understood taht both boys and girls received red packets containing money and envelopes. There were two envelopes of different colors. Envelops with identical graphic designs contained the same nominal amount of money, whereas envelopes with different designs contained different amounts. Both boys and girls received the same nominal amount of money. The question explicitly states this (while pointing to the sentence: "so that both children have the same nominal amount)*

SKT confidently conveyed that all test items were answered correctly. This assertion was further reinforced by SKT's written responses, which aligned with statements made during the interview. Table 5 presents SKT's written answers alongside corresponding interview excerpts.

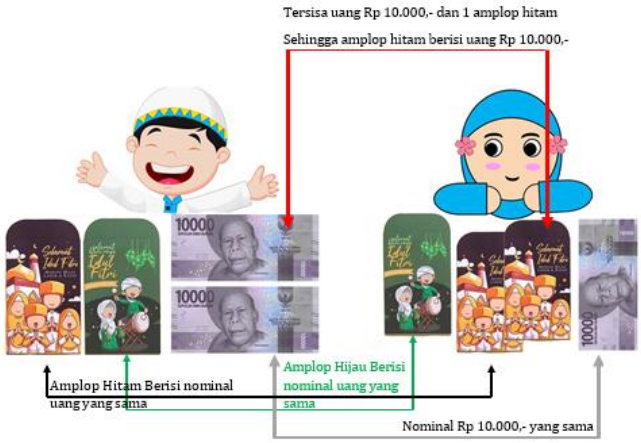
Table 5. Algebraic Thinking Test and Interview Results

No	Algebraic Thinking Test Result	Interview Response
1	Berikan tanda panah pasangan yang sesuai Laki-laki / Perempuan 100 a. — i. x x b. — ii. 2x y c. — iii. x + y Algebraic Form "Structure" Test  "How Much Rupiah" Test	"For number 1, in my opinion, 100 and 2x are the correct expressions"
		"For number 1, the boy receives Rp 100,000, and the girl receives two green envelopes. To ensure the girl receives the same amount as the boy, each green envelope must contain Rp 50,000. With two identical green envelopes, the girl ultimately receives Rp 100,000, just like the boy."
2	Berikan tanda panah pasangan yang sesuai Laki-laki / Perempuan 100 a. — i. x x b. — ii. 2x y c. — iii. 20 + x Algebraic Form "Structure" Test  "How Much Rupiah" Test	*"for number 2, the correct expressions are 100 and 20 + x"*
		"For number 2, the boy receives Rp 100,000, while the girl receives Rp 20,000 and one black and orange envelope. To equalize the amounts, the black and orange envelope must contain Rp 80,000, since the illustration suggests that Rp 20,000 is already accounted for."
3	 Laki-laki: x + y / Perempuan: y + 50 Algebraic Form "Structure" Test	*"I used variables, sir. I represented the green envelope as x and the black envelope as y. For number 3, the boy's amount is x + y, while the girl's amount is y + 50."*

No	Algebraic Thinking Test Result	Interview Response
4	 "How Much Rupiah" Test  Algebraic Form "Structure" Test  "How Much Rupiah" Test	*"I applied concepts from PLSV and PLDV, sir. I performed simple calculations like this (the subject shows calculations identical to those written on the answer sheet)."* *"For number 4, the boy's amount is x + y + 20, while the girl's amount is x + 2y + 10."* *"I applied concepts from PLSV and PLDV, sir. I performed simple calculations like this (the subject shows calculations identical to those written on the answer sheet)."*

In addition to correctly answering each test item, as demonstrated in Table 5, SKT was also able to provide alternative solutions. Table 6 presents the alternative approaches proposed by SKT.

Table 6. Alternative Solutions Provided by SKT

Question Illustration	Subject's Alternative Answer
	 "*Hmm… (the subject pauses to think). There is another way to approach this without calculations, although I am somewhat uncertain, sir. I can analyze the picture instead. For example, in number 4, both boys and girls received the same green envelope (while pointing to the green envelopes). The boy receives Rp 20,000, and the girl receives Rp 10,000. If we assume this (while pointing to a Rp 20,000 bill), then the girl receives two Rp 10,000 bills. To balance the amounts, we place one Rp 10,000 bill inside the black envelope for the girl).*"

Description of Algebraic Thinking of Medium-Ability Students

Medium-ability students (SKS) demonstrated an understanding of the information presented in the problem but were unable to complete all test items thoroughly. SKS struggled to independently comprehend each aspect of the test questions and relied on peer explanations to grasp the information. While SKS appeared confident in the correctness of answers for items

1 and 2, there was noticeable uncertainty regarding items 3 and 4. This lack of confidence was evident in the interview responses.

Interviewer (P) : *Are you confident in the answers you wrote on the test answer sheet?*
SKS : *I don't know sir, I'm not too sure. Maybe I'm sure the answer to numbers 1 and 2 is correct, but for numbers 3-4 I'm not sure of the answer because I only guessed the answer.*

On the TBA answer sheet, SKS correctly answered items 1 and 2 but was unable to solve items 3 and 4 accurately. In general, SKS struggled to construct an appropriate mathematical model for the given problem, which led to errors in the responses. As a result, the answers recorded on the TBA answer sheet did not yield the correct solutions. Additionally, during the interview, SKS expressed difficulty in solving mathematical problems, particularly those presented in visual form. This challenge was reflected in the following interview excerpt.

SKS : *I feel confused, sir, when I see questions presented in picture form. The teacher needs to explain examples of such questions first. Maybe I could solve them if I still remember the explanation, sir.*

Description of Algebraic Thinking in Low-Ability Students

Low-ability students (SKR) were unable to correctly solve the given test items. This was evident from SKR's TBA answer sheet, which contained careless responses, unanswered items, and blank spaces. During the interview, SKR admitted to struggling with the problem-solving process, although at times, SKR attempted to seek guidance from peers.

P : *How did you approach solving this problem?*
SKR : *Hehehe… I don't know, sir. I just counted randomly. At first, I looked at my friend's answer, then I tried to calculate it myself.*

SKR appeared confused and uncertain about how to solve the given problems, ultimately providing only approximate answers without a clear understanding of the solution process.

Discussion

Based on the research objectives, this section describes the algebraic thinking of eighth-grade students at MTs Unggulan PP Amanatul Ummah Surabaya. According to (Sudijono, 2015), students' algebraic thinking abilities in this study are categorized into three levels: high, medium, and low. Algebraic thinking refers to students' capacity to solve algebraic problems. (Lenz, 2022) classifies algebraic thinking into two main categories: the Number-Oriented Approach and the Structure-Oriented Approach. The Number-Oriented Approach emphasizes specific numerical values and relies on procedural calculations, whereas the Structure-Oriented Approach focuses on a structural perspective, interpreting mathematical expressions and equations holistically rather than as isolated computational steps.

To assess students' algebraic thinking, four test items were designed based on two categories (Lenz, 2022). Items 1 and 2 represent the Number-Oriented Approach, in which the

nominal amounts received by the boys and girls are explicitly stated as Rp 100,000. In contrast, Items 3 and 4 represent the Structure-Oriented Approach, where the total nominal amounts are not explicitly provided, requiring students to construct the mathematical relationships themselves.

Algebraic Thinking in High-Ability Students (SKT)

The results indicate that high-ability students (SKT) successfully solved all test items accurately. In items 1 and 2, SKT was able to determine numerical values using appropriate calculation procedures. The question "How much Rupiah?" was answered correctly based on precise calculations, categorizing SKT within the Number-Oriented Approach, Level 2 (A2). Furthermore, in items 3 and 4, SKT not only solved the problems correctly but also provided alternative solutions. The question "How much Rupiah?" in these items was answered correctly by S1 and S2, demonstrating their ability to construct mathematical models and establish relationships between mathematical objects, particularly in relation to the equality sign (=) (Freiman & Lee, 2004; Napaphun, 2012). Consequently, SKT is categorized within the Structure-Oriented Approach, Level 3 (R3).

Algebraic Thinking in Medium-Ability Students (SKS)

Medium-ability students (SKS) demonstrated an understanding of the given problems but were unable to complete all test items thoroughly. In items 1 and 2, SKS correctly answered the "How much Rupiah?" question using appropriate calculation procedures, categorizing them within the Number-Oriented Approach, Level 2 (A2). However, SKS struggled to solve items 3 and 4 correctly. Interview results revealed that SKS was unable to formulate mathematical equations in algebraic form due to a lack of familiarity with writing known and unknown elements of a problem. SKS also faced difficulties in constructing algebraic expressions, as they were accustomed to solving problems through direct calculations rather than abstract representations.

Algebraic Thinking in Low-Ability Students (SKR)

Low-ability students (SKR) were unable to independently comprehend the given problems and required assistance to interpret the information. Interview results indicated that SKR lacked the ability to translate problem information into algebraic expressions due to difficulties in understanding visual representations. Additionally, SKR struggled with algebraic concepts, which contributed to their inability to solve the problems correctly.

Factors Affecting Students' Algebraic Thinking Ability

The primary factor contributing to students' limited algebraic thinking ability is the lack of practice problems that facilitate algebraic reasoning during classroom instruction. As a result, students struggle to interpret problems presented in visual form, leading to deficiencies in problem-solving skills (Yani et al., 2016). Another contributing factor is SKR's lack of understanding of algebraic forms, which serve as the foundation for solving two-variable linear

equations. Without a grasp of algebraic structures, SKR is unable to formulate the necessary rules for problem-solving.

Conclusion

The researcher anticipates several outcomes from this study, including: For teachers – This study can serve as an initial reference to help educators design lessons that align with students' thinking and reasoning needs. Additionally, teachers are encouraged to place greater emphasis on students' algebraic thinking and actively train them to enhance their problem-solving skills in algebraic contexts. For future researchers – It is expected that subsequent studies will explore further and experimental research by implementing targeted interventions to improve students' algebraic thinking skills, particularly in solving pictorial problems.

Declarations

Author Contribution	:	MBD: Conceptualization, Writing - Original Draft, Visualization. S: Methodology, Validation, Supervision. SI: Writing - Review & Editing, Formal Analysis.
Funding Statement	:	No funding.
Conflict of Interest	:	The authors declare no conflict of interest.
Additional Information	:	No additional information is available for this paper.

References

Abdima. (2023). *Karakteristik madrasah*. Abdi Madrasah. https://www.abdimadrasah.com/p/karakteristik-madrasah.html

Alibali, M. (2005). *Understanding of symbols at the transition from arithmetic to algebra: the equal sign and letters as variables*. Bookings Institution, Falk Auditorium.

Amalliyah, N., Wardono, W., & Mulyono, M. (2022). Analisis kemampuan berpikir aljabar siswa ditinjau dari adversity quotient. *Vygotsky*, *4*(1), 1. https://doi.org/10.30736/voj.v4i1.420

Anggraeni, R., & Herdiman, I. (2018). Kemampuan pemecahan masalah matematik siswa smp pada materi lingkaran berbentuk soal kontekstual ditinjau dari gender. *Jurnal Numeracy*, *5*(1), 19–28. https://doi.org/10.46244/numeracy.v5i1.293

Creswell, J.W. (2012). *Qualitative inquiry & research design: choosing among five approaches* (3rd ed.). Amerika: SAGE Publications.

Freiman, V., & Lee, L. (2004). Tracking primary students's understanding of the equality sign. *Proceedings of Rhe 28th Conference of the International Group for the Psychology of Mathematics Education*, 415–422.

Hardianti, A., & Kurniasari, I. (2019). Kemampuan berpikir aljabar siswa smp dalam menyelesaikan masalah matematika. *Jurnal Ilmiah Pendidikan Matematika*, *1*(5), 59–66. https://doi.org/10.26740/mathedunesa.v9n1.p82-87

Harini, L.P.I., & Oka, T.B. (2016). Penggunaan mind map dalam pembuktian matematika. *Jurnal Matematika*, *6*(1), 56–67. https://doi.org/10.24843/JMAT.2016.v06.i01.p68

Hidayanto, E., Purwanto, Subanji, & Rahardjo, S. (2014). Transisi dari berpikir aritmetis ke berpikir aljabaris. In *disertasi dan tesis program pascasarjana um. profil berpikir relasional siswa smp dalam memecahkan masalah aljabar ditinjau dari kemampuan* (1).

Indonesia., K.A.R. (2019). *Keputusan menteri agama nomor 184 tahun 2019 tentang pedoman implementasi kurikulum pada madrasah*.

Indonesia, K.P. (2006). *Peraturan menteri pendidikan nasional nomor 22 tahun 2006 tentang standar isi.*

Kamarullah. (2017). Pendidikan matematika di sekolah kita. *Al Khawarizmi: Jurnal Pendidikan Dan Pembelajaran Matematika*, *1*(1), 21–32. https://doi.org/10.22373/jppm.v1i1.1729

Kieran, C. (2014). *Conceptualizing the learning of algebraic technique: role of tasks and technology*.

Krismanto, A. (2004). *Aljabar*. Malang: Pusat Pengembangan Penataran Guru (PPPG) Matematika.

Kusumaningsih, W., & Herman, T. (2018). Improvement Algebraic Thinkung Ability Using Multiple Representation Strategy on Realistic Mathematics Education. *Journal on Mathematics Education*, *9*(2), 281–290. https://doi.org/10.22342/jme.9.2.5404.281-290

Lenz, D. (2022). The role of variables in relational thinking : an interview study with kindergarten and primary school children. *ZDM – Mathematics Education*, *54*(6), 1181–1197. https://doi.org/10.1007/s11858-022-01419-6

Muallif. (2023). *Madrasah tsanawiyah (mts) kurikulum dan perbedaannya dengan smp*. Universitas Islam An Nur Lampung. https://an-nur.ac.id/madrasah-tsanawiyah-mts-kurikulum-dan-perbedaannya-dengan-smp/

Napaphun, V. (2012). Relational thinking: arithmetic in order to promote algebraic thinking. *Journal of Science and Mathematics Education in Southeast Asia*, *35*(2), 84–101. https://eric.ed.gov/?id=EJ1001766

Priyanto, & Agus. (2013). Penerapan metode stad dalam peningkatan pembelajaran matematika di sekolah dasar. *Kalam Cendika PGSD Kebumen*, *2*(1). http://jurnal.fkip.uns.ac.id/index.php/pgsdkebumen/article/view/368

Sanit, I.N., & Sulandra, I.M. (2019). Profil penalaran aljabaris siswa dalam memecahkan masalah matematika ditinjau dari adversity quotient. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *4*(9), 1213–1221. https://journal.um.ac.id/index.php/jptpp/article/view/12711/5898

SEO. (2023). *Mengenal perbedaan smp dan mts sebelum memilih pendidikan anak*. Share Link. https://sekolah.link/informasi-sekolah/sekolah-smp/

Shadiq, F. (2014). *Strategi pemodelan pada pemecahan masalah matematika*. Yogyakarta: Graha Ilmu.

Siahaan, E.M., Dewi, S., & Said, H.B. (2018). Analisis kemampuan pemecahan masalah matematis berdasarkan teori polya ditinjau dari gaya kognitif field dependent dan field trigonometri kelas x sma n 1 kota jambi. *Jurnal Pendidikan Matematika*, *2*(2), 100–110. https://doi.org/10.33087/phi.v2i2.37

Stacey, K. (2011). The pisa view of mathematical literacy in Indonesia. *Journal on Mathematics Education*, *2*(2), 95–126. https://doi.org/10.22342/jme.2.2.746.95-126

Subanji, S. (2011). *Teori berpikir pseudo penalaran kovariasional*. Malang: UM Press.

Sudijono, A. (2015). *Pengantar statistik pendidikan*. Depok: PT. Raja Grafindo Persada.

Sukmawati, A. (2015). Berpikir aljabar dalam menyelesaikan masalah matematika. *Math Didactic: Jurnal Pendidikan Matematika*, *1*(2), 88–93. https://doi.org/0.33654/math.v1i2.5

Widyawati, Astuti, D., & Ijudin, R. (2018). Kemampuan berpikir aljabar siswa dalam menyelesaikan soal cerita ditinjau berdasarkan kemampuan matematika. *Jurnal Pendidikan Dan Pembelajaran Khatulistiwa (JPPK)*, *7*(9), 1–8. https://doi.org/10.26418/jppk.v7i9.28886

Yani, M., Ikhsan, M., & Marwan. (2016). Proses berpikir siswa sekolah menengah pertama dalam memecahkan masalah matematika berdasarkan langkah-langkah polya ditinjau dari adversity quotient. *Jurnal Pendidikan Matematika*, *10*(1), 42–57. https://doi.org/10.22342/jpm.10.1.3278.42-57

Zulfah. (2019). Analisis kemampuan peserta didik smp di bangkinang melalui penyelesaian soal pisa 2015. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *3*(2), 350–362. https://doi.org/10.31004/cendekia.v3i2.126