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A Data-Driven Contextual Learning Model for Developing Students' Algebraic and Analytical Thinking

Dimas Safitri[1]*, Mira Maharani[2], Teguh Rohman[3]
[1,2] Department of Educational Technology, Faculty of Education, Universitas Negeri Malang, Malang, Indonesia
[3] Department of Physical Education, Faculty of Sports Science, Universitas Negeri Jakarta, Jakarta, Indonesia

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ABSTRACT

This qualitative study aims to analyze how a data-driven contextual learning model develops students' algebraic and analytical thinking in mathematics learning. The study responds to the problem that many students still understand algebra procedurally and struggle to connect symbols, variables, and patterns with real-life contexts. A qualitative case study design was used at a public junior high school in Indonesia from December 2025 to February 2026. Participants consisted of Grade VIII students, one mathematics teacher, and 9 to 12 selected student informants representing high, medium, and low initial mathematical ability. Data were collected through semi-structured interviews, limited participatory observation, documentation of student worksheets, teacher reflection notes, and classroom learning artifacts. Thematic analysis was used to identify patterns of meaning from the data. The findings reveal four main themes: the shift from procedural algebra to contextual algebraic meaning, the growth of analytical reasoning through data interpretation, collaborative meaning-making during classroom interaction, and remaining conceptual obstacles in translating data into algebraic representation. The study contributes to mathematics education by showing that contextual data can help students interpret variables, identify relationships, and justify algebraic expressions more meaningfully. These findings imply that teachers should use familiar data, structured scaffolding, and reflective discussion to support algebra learning. Further research can examine this model across different topics, grade levels, and school contexts.

***) Corresponding Author:**

Dimas Safitri,
Department of Educational Technology, Faculty of Education, Universitas Negeri Malang, Malang, Indonesia
Email: dimas.safitri054@gmail.com

1. Introduction

The development of global mathematics education places algebraic thinking and analytical thinking as essential competencies in twenty-first-century learning. Students are no longer expected only to master computational procedures. They also need to identify patterns, interpret data, connect variables, and construct logical mathematical arguments. Wang, Mohd Matore, and Rosli (2025) state that analytical thinking in mathematics helps students decompose complex problems, evaluate evidence, and develop accountable solutions. Setiana, Purwoko, and Sugiman (2021) show that mathematics learning models designed to stimulate critical thinking can strengthen students' ability to analyze problem-solving steps. Syaiful, Kamid, Kurniawan, and Pratama (2021) also found that problem-based learning supports mathematical analytical thinking because students are trained to observe, classify, and draw relationships among concepts. Ahdhianto, Marsigit, Haryanto, and Santi (2020) explain that metacognitive-based contextual learning can improve problem-solving and mathematical communication because students engage in more conscious and reflective thinking processes.

In the Indonesian context, mathematics learning still faces a strong procedural orientation in classroom practice. Many students can follow worked examples, but they struggle when they must explain reasoning, read relationships among symbols, or apply algebraic concepts to contextual problems. Sidik, Suryadi, and Turmudi (2021) found that learning obstacles in basic mathematical operations can affect the development of algebraic thinking because students are not yet accustomed to seeing structural relationships in numbers. Ruli, Juandi, Dahlan, and Maudy (2025) show that the transition from arithmetic to algebra is often disrupted by epistemological obstacles, especially when students treat symbols only as operational signs. Wahyuni, Herman, and Fatimah (2023) emphasize that students' understanding of letters in algebra is a key point in the transition from arithmetic thinking to algebraic thinking. Yıldız and Yetkin Özdemir (2021) add that this transition depends strongly on teachers' knowledge in helping students understand variables, generalization, and mathematical relations.

Classroom problems indicate that students' difficulties in algebra do not only relate to formula mastery. They also relate to learning experiences that are not sufficiently connected to real contexts. Teachers often present algebra as a set of symbolic rules, so students do not always understand why a symbol is used and how mathematical relationships are formed. Supriadi, Putra, and Fitriani (2022) show that a realistic mathematics approach can help students understand concepts because learning begins with situations that students can imagine and analyze. Suryadi, Itoh, and Isnarto (2023) emphasize the importance of lesson planning that considers the relationship among tasks, contexts, and students' responses so that mathematical thinking can develop more deeply. Ridwan, Retnawati, Hadi, and Jailani (2022) found that teachers' perspectives on critical thinking in mathematics strongly shape the strategies used in classroom learning. Safitri and Masduki (2023) also show that qualitative exploration of students' algebraic thinking can reveal how students understand symbols, patterns, and mathematical relationships in more detail.

A data-driven contextual learning model becomes relevant because it can connect algebraic concepts with data that are close to students' lives, such as school environmental data, consumption patterns, classroom survey results, weather changes, or social information around them. When students read real data, they do not only calculate. They also interpret meaning, compare trends, make generalizations, and construct mathematical arguments. Gligorea, Cioca, Oancea, Gorski, and Gorski (2023) explain that technology-based adaptive learning can strengthen learning personalization when data are used to understand students' needs and development. Alamri, Lowell, Watson, and Watson (2020) show that personalized learning can increase motivation because students feel that the learning process is more relevant to their needs and experiences. Attard and Holmes (2022) found that blended learning in mathematics classrooms provides space for more flexible interaction, exploration, and reflection. Bağ and Gürsoy (2021) also emphasize that learning designs embedded with critical thinking can help students develop deeper and more structured reasoning.

Although many studies have examined contextual learning, problem-based learning, realistic mathematics education, and technology-based learning, a research gap remains in the process of meaning construction in data-driven algebra learning. Most previous studies still assess the effectiveness of learning models through quantitative achievement outcomes, while students' experiences in reading data, building algebraic relationships, and developing analytical thinking have not been deeply explained. Wang et al. (2025) state that research on analytical thinking in mathematics education still requires stronger exploration of students' thinking processes. Wijaya, Nusantara, Sudirman, and Hidayanto (2023) show that students' prior knowledge affects the way they analyze mathematical concepts, so thinking processes cannot be understood only from final answers. Steflitsch and Kollosche (2025) demonstrate that students' perceptions and experiences can provide important understanding of how mathematics learning is interpreted in classroom situations. Ahdhianto et al. (2020) also emphasize the importance of metacognitive processes in contextual learning, which makes qualitative research necessary to understand how students become aware of, control, and explain their thinking processes.

Based on these issues, this study aims to analyze a data-driven contextual learning model in developing students' algebraic thinking and analytical thinking. The study focuses on students' experiences when reading contextual data, building relationships among variables, explaining algebraic patterns, and constructing mathematical reasoning during the learning process. Theoretically, this study strengthens the perspectives of constructivism and contextual learning because mathematical knowledge is understood as the result of active construction through experience, interaction, and reflection. Setiana et al. (2021) show that mathematics learning that stimulates critical thinking can help students build more coherent thinking steps. Sidik et al. (2021) indicate that learning obstacles need to be analyzed from the early stages so that algebra learning does not stop at mechanical procedures. Ruli et al. (2025) emphasize that understanding the transition from arithmetic to algebra requires attention to how students interpret symbols and structures. Therefore, this study is expected to provide practical contributions for teachers in designing algebra learning that is data-driven, contextual, and responsive to students' thinking needs.

2. Materials and Methods

This study employed a qualitative approach with a case study design. This design was selected because the study focused on gaining an in-depth understanding of the implementation process of a data-driven contextual learning model in developing students' algebraic and analytical thinking. A case study design is appropriate because this study did not only assess the final results of learning. It also examined students' experiences, interactions, strategies, and thinking processes in a real classroom context. In mathematics education research, a qualitative approach is relevant for exploring how students construct meaning, use algebraic symbols, interpret data, and explain mathematical reasoning. Safitri and Masduki (2023) show that a qualitative case study can be used to explore students' algebraic thinking through tests, questionnaires, and interviews. Steflitsch and Kollosche (2025) also emphasize that student interview data can provide detailed insights into students' perceptions, experiences, and challenges in context-based mathematics learning.

The study was conducted at a public junior high school in Indonesia during the even semester of the 2025/2026 academic year, from December 2025 to February 2026. The research subjects consisted of Grade VIII students who participated in algebra learning through a data-driven contextual learning model, one mathematics teacher, and several students selected as key informants. Participants were selected using purposive sampling with the following criteria: students had studied algebraic forms and linear equations, actively participated in the learning process, were able to express their learning experiences verbally, and represented high, medium, and low initial mathematics ability levels. The key informants consisted of 9 to 12 students and one mathematics teacher. Informant selection could be expanded through snowball sampling when the teacher recommended students with distinctive learning experiences, such as students who showed notable changes in analyzing data, identifying patterns, or explaining relationships among variables. A small and focused sample was used to allow the researcher to explore students' experiences in depth, not to produce statistical generalization.

Data were collected through semi-structured interviews, limited participatory observation, documentation, and triangulation of learning data. Semi-structured interviews were used to explore students' experiences in reading contextual data, transforming data into algebraic forms, explaining patterns, and constructing analytical reasoning. Observations were conducted during the learning process to record students' activities, interaction patterns, teacher strategies, responses to data-based tasks, and students' ways of discussing problems in groups. Documentation included teaching modules, student worksheets, reflection notes, data-based algebra tasks, photographs of learning activities, and researcher field notes. The main research instrument was the researcher, while interview guidelines, observation sheets, and document analysis formats were used as supporting instruments. Data validation was carried out through source and method triangulation, member checking with selected informants, and an audit trail containing records of data collection processes, analytical decisions, code revisions, and researcher reflections. Ahmed (2024) explains that credibility, transferability, dependability, and confirmability can be strengthened through triangulation, member checking, thick description, and audit trails.

Data were analyzed using thematic analysis through repeated stages of data reduction, data display, and conclusion drawing. The analysis began with interview transcription and organization of observation notes, followed by close reading to identify units of meaning related to algebraic thinking and analytical thinking. The researcher conducted initial coding on data that showed activities such as recognizing patterns, understanding variables, connecting data with symbols, formulating conjectures, testing reasoning, and explaining solution procedures. These codes were then grouped into categories, such as understanding data contexts, algebraic representation strategies, forms of analytical reasoning, conceptual obstacles, and the role of classroom interaction. The categories were then developed into main themes explaining how the data-driven contextual learning model shaped students' experiences and thinking processes. Bingham (2023) emphasizes that qualitative analysis needs to be conducted systematically through data management, inductive and deductive coding, analytical memos, and documentation of the analytical process. Kushnir (2025) also explains that thematic analysis in education is useful for identifying patterns of meaning from qualitative data in a structured way.

3. Results and Discussions

The findings of this study indicate that the data-driven contextual learning model supported the development of students' algebraic and analytical thinking by changing how they understood algebraic concepts, interpreted data, and constructed mathematical reasoning. The analysis of interview transcripts, classroom observations, student worksheets, and teacher reflection notes produced four major themes. These themes were: the shift from procedural understanding to contextual algebraic meaning, the growth of analytical reasoning through data interpretation, the role of collaborative interaction in constructing mathematical understanding, and the persistence of conceptual obstacles in translating data into algebraic representation. These themes show that students' thinking did not develop instantly. It moved gradually through repeated exposure to contextual data, teacher scaffolding, peer discussion, and reflective explanation. The learning process helped students see algebra not only as a formal topic in textbooks, but also as a tool for explaining patterns and relationships in everyday situations.

The first theme concerns students' shift from procedural understanding to contextual algebraic meaning. At the beginning of the learning process, most students viewed algebra as a difficult topic because it involved letters, symbols, and rules that appeared separate from their daily experiences. Interview data showed that several students initially associated algebra with memorizing formulas and following teacher examples. One student explained, "Before this lesson, I only followed the example from the board. I did not know why the letter was used." This statement illustrates that students' early understanding of algebra was still procedural and dependent on imitation. However, when the teacher introduced data from familiar contexts, such as classroom survey results, school canteen prices, daily water consumption, and simple environmental observations, students began to connect algebraic symbols with quantities that changed. Observation notes showed that students became more engaged when they recognized that the data came from situations close to their lives. They started to discuss what changed, what stayed the same, and how the relationship could be represented using symbols. This process helped students understand that variables do not appear randomly in algebraic expressions. Variables represent quantities that can vary within a given situation.

The second theme relates to the development of analytical reasoning through data interpretation. Students' analytical thinking became visible when they compared data, identified regularities, examined differences, and justified their conclusions. In one activity, students analyzed a table showing the relationship between the number of items purchased and the total cost at the school canteen. At first, some students only added numbers without explaining the relationship between the two columns. After the teacher asked guiding questions, such as "What changes every time the number of items increases?" and "What pattern do you see in the total cost?", students began to identify repeated changes and connect them to algebraic expressions. One student stated, "When I looked at the table, I saw that the total kept increasing by the same amount, so I tried to write it with a letter." This response shows that the student was no longer focused only on calculation, but had started to reason about relationships. Student worksheets also showed that several students added short explanations beside their answers, such as "the number changes, but the price for each item is fixed" or "the pattern increases regularly." These written explanations indicate that students began to use evidence from data to support their algebraic reasoning.

The third theme concerns collaborative meaning-making during classroom interaction. The data show that students' understanding developed not only through individual thinking, but also through peer discussion and teacher guidance. During group work, students often compared different answers and debated which algebraic expression best represented the data. Some groups initially produced incorrect expressions because they focused only on the final number. However, after discussing with peers, they revised their answers and gave clearer explanations. One student said, "I understood the pattern after my friend explained why the number increased by the same amount." This statement shows that peer explanation helped students recognize relationships that they had not noticed before. Classroom observations also showed that the teacher played an important role in maintaining the direction of discussion. The teacher did not immediately provide the correct answer. Instead, the teacher asked probing questions that encouraged students to examine the data again. This interaction created a learning environment where students could test ideas, identify mistakes, and refine their reasoning. Documentation from group worksheets showed several corrections, crossed-out answers, and revised expressions, which indicate that learning occurred through negotiation and reflection.

The fourth theme reveals that conceptual obstacles remained even though students showed meaningful progress. Some students still had difficulty distinguishing between variables, constants, and coefficients. Others could identify a numerical pattern but struggled to translate it into symbolic form. This difficulty appeared more clearly among students with lower initial mathematical ability. One participant stated, "I can see that the numbers go up, but I am confused about how to write the letter part." This statement reflects a common obstacle in algebra learning, where students can recognize a pattern informally but cannot yet express it formally. Observation notes also showed that students needed more support when the data involved more than one changing quantity. For example, when students worked with data that included both the number of students and total consumption, some groups confused which quantity should become the variable. This finding indicates that contextual data can help students understand algebra, but it does not automatically remove all conceptual difficulties. Students still need carefully sequenced tasks, repeated examples, and explicit guidance that connects concrete data to symbolic representation.

Overall, the results suggest that the data-driven contextual learning model created a more meaningful pathway for developing algebraic and analytical thinking. Students learned to read data, recognize patterns, identify relationships, and express those relationships through algebraic symbols. The model also encouraged students to explain their reasoning, revise their answers, and connect mathematical ideas with real situations. However, the findings also show that students' progress depended on several conditions, including prior knowledge, task clarity, teacher scaffolding, and peer interaction. Students who had stronger prior understanding could move more quickly from data interpretation to symbolic representation. Students with weaker prior knowledge required more time and more structured support. These findings highlight that contextual learning should not only present real-world problems, but also guide students through a clear thinking process from observation, interpretation, representation, and explanation.

Discussion

The findings of this study support the constructivist view that students develop mathematical understanding through active engagement with meaningful experiences. In this study, students did not receive algebraic concepts as fixed rules to memorize. They constructed understanding through interaction with contextual data, classroom discussion, and reflective explanation. This finding is consistent with Ahdhianto et al. (2020), who found that metacognitive-based contextual learning supports students' problem-solving and mathematical communication because students become more aware of their thinking processes. It also aligns with Supriadi et al. (2022), who showed that realistic mathematics learning helps students understand concepts when learning begins from situations that can be imagined and analyzed. The present study extends these findings by showing that data-driven contextual learning can connect algebraic thinking with analytical thinking. Students did not only solve algebraic tasks. They also interpreted information, compared data, identified relationships, and justified the meaning of their algebraic expressions.

The shift from procedural algebra to contextual algebraic meaning also confirms the importance of helping students understand the role of symbols. Students initially saw algebraic letters as confusing signs that appeared in formulas. After working with contextual data, they began to understand that letters can represent changing quantities in real situations. This finding supports Wahyuni et al. (2023), who emphasized that understanding letters in algebra is a central part of the transition from arithmetic thinking to algebraic thinking. It also supports Sidik et al. (2021), who found that learning obstacles in basic mathematical operations can influence students' ability to develop algebraic thinking. In this study, contextual data helped reduce the distance between arithmetic experience and algebraic representation. Students first observed numerical changes in data, then described the pattern verbally, and finally represented it using symbols. This sequence shows that symbolic understanding becomes stronger when students pass through concrete and verbal stages before entering formal algebraic notation.

The development of analytical reasoning in this study was closely related to students' ability to interpret data and provide evidence for their answers. When students analyzed tables, compared quantities, and explained repeated changes, they practiced the basic processes of analytical thinking. This finding is in line with Wang et al. (2025), who describe analytical thinking in mathematics as the ability to break down problems, evaluate evidence, and construct reasoned conclusions. It also supports Syaiful et al. (2021), who found that problem-based learning can strengthen mathematical analytical thinking because students are trained to observe, classify, and relate concepts. However, this study offers a more specific contribution by showing that contextual data can serve as a bridge between algebraic representation and analytical reasoning. Students' algebraic thinking developed not only when they wrote expressions, but also when they explained why the expression matched the data. This shows that algebraic understanding and analytical reasoning should not be treated as separate competencies in classroom learning.

The role of classroom interaction also deserves attention. The findings show that students' understanding improved when they had opportunities to discuss, question, and revise their ideas with peers. Group discussion allowed students to compare interpretations and identify errors that they might not have noticed individually. Teacher scaffolding also helped students focus on relationships rather than final answers. This finding is consistent with Ridwan et al. (2022), who showed that teachers' perspectives and classroom strategies influence the development of critical thinking in mathematics learning. It also supports Suryadi et al. (2023), who emphasized that lesson planning must consider the relationship among tasks, contexts, and student responses. In this study, teacher questions helped students move from surface-level observation to deeper mathematical reasoning. For example, questions about what changed, what remained constant, and how the relationship could be written symbolically helped students connect data patterns with algebraic structures. This indicates that data-driven contextual learning requires active teacher facilitation, not only the provision of contextual tasks.

The persistence of conceptual obstacles shows that contextual learning should be designed carefully. Although students became more engaged and showed better understanding, some still struggled to translate observed patterns into algebraic expressions. This finding supports Ruli et al. (2025), who found that the transition from arithmetic to algebra often involves epistemological obstacles. It also aligns with Yıldız and Yetkin Özdemir (2021), who argued that teachers need strong subject matter knowledge to support students in moving from arithmetic reasoning to algebraic reasoning. The present study shows that students may understand a pattern informally but still fail to express it formally. This means that teachers need to provide gradual learning steps, starting from real data, verbal explanation, tabular representation, pattern recognition, symbolic notation, and mathematical justification. Without this sequence, students may enjoy contextual activities but still fail to reach formal algebraic understanding.

Theoretically, this study strengthens the connection between constructivism, contextual learning, algebraic thinking, and analytical thinking. The findings show that students' mathematical understanding develops through interaction among experience, data, language, symbols, and reflection. Data-driven contextual learning offers a learning structure that allows students to move from concrete situations to abstract reasoning. It also shows that analytical thinking can emerge naturally when students are asked to interpret data and justify mathematical relationships. Practically, the findings suggest that teachers should use familiar data sources in algebra learning, such as classroom surveys, school canteen prices, attendance patterns, environmental observations, or students' daily routines. These data can help students see algebra as a useful tool for understanding real situations. Future research can examine this model in different grade levels, different algebra topics, or different school contexts. Further studies may also use mixed methods to examine both the process of meaning construction and measurable changes in students' algebraic and analytical thinking.

4. Conclusions

This study concludes that the data-driven contextual learning model supports the development of students' algebraic and analytical thinking by connecting abstract algebraic concepts with meaningful data from students' real learning environment. The findings show that students gradually shifted from procedural understanding toward contextual algebraic meaning, especially when they interpreted data, identified patterns, explained relationships among variables, and represented those relationships using algebraic expressions. The study also shows that analytical thinking emerged through data comparison, evidence-based reasoning, group discussion, and reflective explanation. However, some students still experienced conceptual obstacles in distinguishing variables, constants, and coefficients, especially when they had to translate informal patterns into formal symbolic representation.

Theoretically, this study strengthens constructivist and contextual learning perspectives by showing that algebraic understanding develops through experience, interaction, data interpretation, and reflection. Practically, the findings suggest that mathematics teachers should design algebra learning using familiar and local data, supported by clear scaffolding questions and structured learning stages. From a policy perspective, curriculum development should provide more space for data-based mathematical tasks that train students to reason, justify, and communicate mathematical ideas. Future research can expand this study by involving different school levels, broader algebra topics, or mixed-method designs to examine both students' thinking processes and measurable learning improvement.

References

Ahdhianto, E., Marsigit, M., Haryanto, H., & Santi, N. N. (2020). The effect of metacognitive-based contextual learning model on fifth-grade students' problem-solving and mathematical communication skills. *European Journal of Educational Research, 9*(2), 753–764. https://doi.org/10.12973/eu-jer.9.2.753

Ahmed, S. K. (2024). The pillars of trustworthiness in qualitative research. *Journal of Medicine, Surgery, and Public Health, 2*, Article 100051. https://doi.org/10.1016/j.glmedi.2024.100051

Alamri, H. A., Lowell, V. L., Watson, W., & Watson, S. L. (2020). Using personalized learning as an instructional approach to motivate learners in online higher education: Learner self-determination and intrinsic motivation. *Journal of Research on Technology in Education, 52*(3), 322–352. https://doi.org/10.1080/15391523.2020.1728449

Attard, C., & Holmes, K. (2022). An exploration of teacher and student perceptions of blended learning in four secondary mathematics classrooms. *Mathematics Education Research Journal, 34*(4), 719–740. https://doi.org/10.1007/s13394-020-00359-2

Bağ, H. K., & Gürsoy, E. (2021). The effect of critical thinking embedded English course design to the improvement of critical thinking skills of secondary school learners. *Thinking Skills and Creativity, 41*, Article 100910. https://doi.org/10.1016/j.tsc.2021.100910

Bingham, A. J. (2023). From data management to actionable findings: A five-phase process of qualitative data analysis. *International Journal of Qualitative Methods, 22*, 1–11. https://doi.org/10.1177/16094069231183620

Gligorea, I., Cioca, M., Oancea, R., Gorski, A. T., Gorski, H., & Tudorache, P. (2023). Adaptive learning using artificial intelligence in e-learning: A literature review. *Education Sciences, 13*(12), Article 1216. https://doi.org/10.3390/educsci13121216

Kushnir, I. (2025). Thematic analysis in the area of education: A practical guide. *Cogent Education, 12*(1), Article 2471645. https://doi.org/10.1080/2331186X.2025.2471645

Ridwan, M. R., Retnawati, H., Hadi, S., & Jailani, J. (2022). Teachers' perceptions in applying mathematics critical thinking skills for middle school students: A case of phenomenology. *Anatolian Journal of Education, 7*(1), 1–16. https://doi.org/10.29333/aje.2022.711a

Ruli, R. M., Juandi, D., Dahlan, J. A., & Maudy, S. Y. (2025). From arithmetic to algebra: Students' epistemological obstacles. *SJME (Supremum Journal of Mathematics Education), 9*(2), 371–382. https://doi.org/10.35706/sjme.v9i2.205

Safitri, R., & Masduki, M. (2023). Exploring secondary students' algebraic thinking in terms of intuitive cognitive style. *EduMa: Mathematics Education Learning and Teaching, 12*(2), 153–165. https://doi.org/10.24235/eduma.v12i2.13568

Setiana, D. S., Purwoko, R. Y., & Sugiman, S. (2021). The application of mathematics learning model to stimulate mathematical critical thinking skills of senior high school students. *European Journal of Educational Research, 10*(1), 509–523. https://doi.org/10.12973/eu-jer.10.1.509

Sidik, G. S., Suryadi, D., & Turmudi, T. (2021). Learning obstacle on addition and subtraction of primary school students: Analysis of algebraic thinking. *Education Research International, 2021*, Article 5935179. https://doi.org/10.1155/2021/5935179

Steflitsch, D., & Kollosche, D. (2025). Students' perceptions of critical mathematics education: An exploration. *Educational Studies in Mathematics*. https://doi.org/10.1007/s10649-025-10423-y

Supriadi, N., Putra, R. W. Y., & Fitriani, F. (2022). Implementation of a realistic mathematics learning approach (PMR) and analytical thinking: The impact on students' understanding of mathematical concepts in Indonesia. *Al-Jabar: Jurnal Pendidikan Matematika, 13*(2), 465–476. https://doi.org/10.24042/ajpm.v13i2.16453

Suryadi, D., Itoh, T., & Isnarto, I. (2023). A prospective mathematics teacher's lesson planning: An in-depth analysis from the anthropological theory of the didactic. *Journal on Mathematics Education, 14*(4), 723–740. https://doi.org/10.22342/jme.v14i4.pp723-740

Syaiful, S., Kamid, K., Kurniawan, D. A., & Pratama, W. A. (2021). Problem-based learning model on mathematical analytical thinking ability and science process skills. *Al-Jabar: Jurnal Pendidikan Matematika, 12*(2), 385–398. https://doi.org/10.24042/ajpm.v12i2.9744

Wahyuni, R., Herman, T., & Fatimah, S. (2023). Letters in algebra as the transition from arithmetic thinking to algebraic thinking. *Mosharafa: Jurnal Pendidikan Matematika, 12*(3), 441–452. https://doi.org/10.31980/mosharafa.v12i3.2369

Wang, M., Mohd Matore, M. E. E., & Rosli, R. (2025). A systematic literature review on analytical thinking development in mathematics education: Trends across time and countries. *Frontiers in Psychology, 16*, Article 1523836. https://doi.org/10.3389/fpsyg.2025.1523836

Wijaya, A. P., Nusantara, T., Sudirman, S., & Hidayanto, E. (2023). How are students' prior knowledge differentiate analytical thinking process in identifying the convergence of real number sequences? *International Journal of Instruction, 16*(1), 205–218. https://doi.org/10.29333/iji.2023.16112a

Yıldız, P., & Yetkin Özdemir, E. (2021). Teacher subject matter knowledge for the meaningful transition from arithmetic to algebra. *Journal of Pedagogical Research, 5*(4), 172–188. https://doi.org/10.33902/JPR.2021474587