Literature Review: The Relationship Between Students' Metacognitive Abilities and Cognitive Styles in Mathematics Learning

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ABSTRACT

This study aims to examine the relationship between students' metacognitive abilities and cognitive styles in mathematics learning through a literature review of 20 relevant scientific articles published between 2016 and 2025. The method employed is a literature study with a narrative approach, in which data were obtained from various databases such as Google Scholar, Semantic Scholar, and Taylor & Francis. The analysis was carried out qualitatively by examining the similarities, differences, and patterns of findings across studies. The results indicate that metacognitive ability and cognitive style have a positive and significant relationship. Students with a Field Independent (FI) cognitive style demonstrate better metacognitive regulation compared to those with a Field Dependent (FD) style, particularly in the aspects of planning, monitoring, and evaluation. Metacognition-based learning approaches, such as the Metacognitive Learning Approach and Project-Based Learning, are proven effective in optimizing the potential of both cognitive styles. Thus, metacognitive ability plays an essential role in fostering students' reflective and adaptive thinking in the context of 21st-century learning.

Keywords: *Metacognitive, Cognitive Style, Field Independent, Field Dependent, Mathematics Learning.*

1) INTRODUCTION

The development of education in the modern era, characterized by technological advancement, demands for critical thinking, and the increasing complexity of real-world problems, requires students to possess more independent and reflective learning abilities. In the context of mathematics learning, these abilities are not only dependent on conceptual mastery but also on how students understand, manage, and regulate their own thinking processes (William & Maat, 2020). This ability is known as metacognitive ability. Metacognition plays an important role in helping students plan problem-solving strategies, monitor their thinking processes, and evaluate the effectiveness of the steps taken (Pasaribu et al., 2025). Students with strong metacognitive abilities tend to be more capable of dealing with complex mathematical problems that require higher-order reasoning skills (Kathayat, 2024). Thus, the effectiveness of metacognitive ability in mathematics learning is strongly influenced by differences in

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how students process information, making it essential to understand the role of cognitive styles in supporting these thinking processes.

These differences in how students process information are reflected in their cognitive styles, which refer to individual characteristics in responding to, processing, storing, thinking about, and organizing information during learning (Yahya et al., 2024). Two cognitive styles most frequently discussed in educational studies are Field Independent (FI) and Field Dependent (FD). FD learners tend to process information globally, are easily influenced by surrounding contexts, and have difficulty distinguishing details from the background. Conversely, FI learners are more capable of analyzing information, separating objects from their context, and understanding content in a more structured manner (Hasan, 2020). These cognitive style differences may influence how students plan, monitor, and apply strategies in mathematical problem-solving, making them an important aspect to consider in understanding variations in metacognitive ability (Sutama et al., 2021).

The relationship between metacognitive ability and cognitive style has become an important topic in mathematics learning because these two aspects interact with one another and influence the quality of students' learning processes. FI learners are known to have a higher tendency for metacognitive regulation, including the ability to plan and evaluate problem-solving strategies (Silaban & Darhim, 2023). In contrast to FI students, FD learners demonstrate limitations in meeting metacognitive indicators and tend to require direct guidance or step-by-step support in order to properly understand problem-solving procedures (Sihotang et al., 2024). Thus, cognitive style not only affects how students process information but also shapes how they develop and utilize metacognitive abilities in mathematics learning situations.

Several previous studies have shown that metacognitive ability is positively correlated with mathematical problem-solving skills, critical thinking ability, and academic achievement (Hunaifi & Juandi, 2023; Zhang et al., 2024). Research also indicates that students with a Field-Independent cognitive style tend to be more capable of analyzing information and solving mathematical problems independently, whereas Field-Dependent students benefit more from social learning situations or from receiving external guidance and support (Dzulfikar & Herman, 2023).). Nevertheless, studies that specifically examine the relationship between metacognitive ability and cognitive style within the context of mathematics learning remain relatively limited. In fact, understanding this relationship is

crucial for designing instruction that aligns with students' characteristics, especially in the era of the Merdeka Curriculum, which emphasizes differentiation and learner autonomy.

Based on the above explanation, it is evident that metacognitive ability plays a crucial role in helping students understand and solve mathematical problems, while cognitive style functions as an individual factor that influences how this ability develops and is applied. However, only a limited number of studies have examined the relationship between the two comprehensively, particularly through an in-depth literature review. The novelty of this research lies in its effort to identify patterns of relationships, trends in findings, and directions for future research related to students' metacognitive abilities and cognitive styles in mathematics learning through a literature-based analysis of various scholarly sources. Theoretically, this literature study provides an in-depth understanding of the interaction between cognitive style and metacognitive regulation within the context of mathematics learning. Practically, the findings are expected to serve as a reference for teachers, researchers, and curriculum developers in designing instructional strategies that accommodate diverse cognitive styles and foster students' metacognitive abilities so they are better prepared to face the challenges of 21st-century mathematics learning.

2) METHODS

This research is a literature study using a narrative approach aimed at examining the relationship between students' metacognitive abilities and cognitive styles in mathematics learning. The literature sources were obtained through searches conducted across various academic databases, such as Google Scholar, Taylor & Francis, and Semantic Scholar. The keywords used in the search process included: metacognitive ability, cognitive style, field independent, field dependent, and mathematics learning.

The literature analyzed was selected based on the following inclusion and exclusion criteria:

a. Articles were published between 2016 and 2025.
b. Articles were available in full-text form.
c. Articles discussed metacognitive ability, FI–FD cognitive styles, or the relationship between the two within the context of mathematics learning.

The initial stage of article screening was carried out using the filtering features available in each database, based on the predetermined inclusion and exclusion criteria. Based on searches conducted across various academic databases, namely Google Scholar and Semantic Scholar, a total of 925 articles

were found to be relevant to the search keywords. These articles were then filtered according to the publication year 2016–2025, resulting in 747 articles that met the time-related criteria. From this number, several articles were identified as duplicates across databases and were removed from the list.

The articles that passed this stage were then selected through three steps, namely title screening, abstract screening, and full-text review. The selection process began with examining the article titles. Articles deemed relevant were then downloaded, and their citations were organized using the Mendeley reference management application. The articles were further processed to remove any remaining duplicates. The selection continued by reviewing the abstracts of each article to assess their alignment with the established inclusion and exclusion criteria. After completing all stages of the selection process, a total of 15 articles met the criteria and were used as the basis for analysis in this literature study.

The collected data were then analyzed qualitatively by examining patterns of relationships, similarities, differences, as well as the strengths and weaknesses of each study to identify trends in the findings related to the relationship between students' metacognitive abilities and cognitive styles in mathematics learning.

3) RESULTS AND DISCUSSION

Table 1: *Results Matrix*

No	Authors and Year	Research Objectives	Research Findings
1	Zakiah (2020)	To describe the levels of students' metacognitive abilities based on their cognitive styles.	FI students tend to be at the reflective use level, whereas FD students more often fall within the strategic use or aware use levels, depending on their level of prior mathematical ability (KAM).
2	Muliawati (2016)	To describe the metacognitive profiles of tenth-grade high school students with field-independent and field-dependent cognitive styles in	Field-independent and field-dependent students share similar metacognitive profiles in the stages of understanding the problem and carrying out the

		solving mathematical problems on quadratic equations and functions.	problem-solving plan. However, in the stages of planning the problem-solving process and checking the solution, field-independent and field-dependent students demonstrate different metacognitive profiles.
3	Sili & Angriani (2018)	To describe the metacognitive processes of FD and FI students in solving mathematical problems.	FD students show weak awareness but perform well in regulating and evaluating; FI students demonstrate strong awareness and regulating but are weaker in evaluating. Both subjects do not exhibit the full set of metacognitive indicators.
4	Limbanadi et al. (2018)	To describe the metacognitive skills of university students with a field-independent cognitive style in solving stoichiometry problems.	Students with a field-independent cognitive style demonstrate good metacognitive skills in the stages of understanding the problem and planning. In the stage of carrying out the plan, students are able to implement the strategies but are not yet able to detect errors. In the evaluation stage, students are able to check and correct the final results of the problem-solving process.
5	Ahna et al. (2022)	To describe students' mathematical problem-	Students with a field-independent cognitive style demonstrate good

		solving abilities based on FI and FD cognitive styles.	metacognitive skills in the stages of understanding the problem and planning. In the stage of carrying out the plan, students are able to implement the strategies but are not yet able to detect errors. In the evaluation stage, students are able to check and correct the final results of the problem-solving process.
6	Agustiningtyas et al. (2023)	To describe the difference in mathematical representation ability between FI and FD students in solving two line equation description problems.	FD students only use two indicators of mathematical representation (mathematical and verbal expressions), and are not precise in understanding the information so that the completion plan does not lead to a solution. FI students use three representation indicators (visual, mathematical, and verbal expressions) sequentially and precisely, and are able to provide alternative solutions.
7	Hidajat et al. (2021)	To identify students' metacognitive skills in mathematical problem-solving based on their cognitive styles	The students were categorized into FI and FD groups. Both groups demonstrated metacognitive activities (planning, monitoring, evaluation, and prediction), but did not fully meet all metacognitive indicators. Both

			FI and FD students were able to write down the facts, check the results, evaluate the steps, and make predictions or conclusions.
8	Laamena & Laurens (2021)	To determine the metacognitive characteristics of prospective mathematics teachers in solving mathematical literacy tasks.	The results of the study show that the mathematical literacy ability of prospective mathematics teachers is in the low category. No subject has achieved a multidimensional literacy level. Metacognitive characteristics differ from group to group: the low group is aware of the wrong strategy but does not fix it, the middle group is starting to monitor the thought process and uses several strategies even though it is not consistent, while the high group is able to use various strategies such as drawing/sketching, analyzing problems, and understanding concepts well. Overall, the level of mathematical literacy is closely related to an individual's metacognitive abilities.
9	Thi-nga et al. (2024)	To present a comprehensive bibliometric analysis of all publications on metacognition in mathematics	This study analyzed 288 publications authored by 653 researchers across 58 countries and found that research on

	education (MiME) indexed in Scopus, with the aim of identifying trends, influential authors, contributing countries, and future research directions.	metacognition in mathematics education has grown rapidly since 2016. The countries with the highest contributions were the United States, followed by Germany, Turkey, Belgium, and Indonesia. The major topics frequently investigated include: (1) adults' metacognitive abilities and gender differences, (2) the relationship between metacognition, problem-solving skills, and academic achievement, and (3) the development and teaching of metacognitive skills in children. Most of the articles were published in psychology and education journals, with only two appearing in mathematics education–specific journals (ZDM and Educational Studies in Mathematics). The researchers concluded that metacognition is a key and continuously growing area in mathematics education and recommended further research on assessment, intervention, and the relationship between metacognition, mathematical

			performance, and gender differences.
10	Tian et al. (2018)	To investigate how metacognitive knowledge influences students' mathematical performance within the framework of self-regulated learning by considering the dual mediating roles of self-efficacy and motivation.	The results of the structural equation modeling analysis showed that metacognitive knowledge indirectly influences mathematical performance through self-efficacy and intrinsic motivation. Self-efficacy and motivation act as dual mediators: students with higher metacognitive knowledge tend to develop stronger self-efficacy and greater learning motivation, which in turn enhance their mathematical achievement. In addition, the direct effect of metacognitive knowledge on mathematical performance was also significant, although partially mediated by these two variables. These findings highlight the importance of fostering metacognition alongside affective factors such as self-efficacy and motivation to improve students' mathematical learning outcomes.
11	Daher & Hashash (2022)	This study aims to develop and validate a questionnaire	The developed questionnaire was found to be valid and reliable in

		designed to measure the extent to which mathematics teachers promote their students' metacognitive processes, including planning, monitoring, regulation, and evaluation. In addition, the study investigates the overall level of these practices and examines whether differences exist based on teachers' gender, academic qualifications, and years of teaching experience.	measuring the four metacognitive practices. Overall, teachers demonstrated varying levels of implementation: planning was rated as 'very good,' evaluation and regulation as 'good,' while monitoring was only at a 'moderate' level. In terms of differences, female teachers significantly outperformed male teachers in promoting planning and regulation. Meanwhile, academic qualifications (S1 vs. S2) and years of teaching experience did not produce significant differences in any of the examined metacognitive practices.
12	Syaiful et al. (2022)	This experimental study aims to investigate the effectiveness of the Metacognitive Learning Approach (MLA) in improving the Mathematical Critical Thinking Skills (MCTS) of mathematics education students. The study compares learning outcomes between a group taught using MLA and a group taught through conventional instruction, and further	The results of the study indicate that the Mathematical Critical Thinking Skills (MCTS) of students who learned through the Metacognitive Learning Approach (MLA) were significantly higher than those of students who learned through conventional instruction. The improvement in MCTS in the experimental group reached 60.37%, which was substantially greater than the 38.33% observed in the control

		examines the improvement of MCTS across subgroups of students with low, medium, and high prior abilities.	group. In addition, MLA was found to be equally effective in enhancing MCTS across all subgroups of students, regardless of whether their prior ability levels were low, medium, or high. Indicator-level analysis also revealed improvements across all aspects of critical thinking, with the highest gain observed in the ability to identify relevance and the lowest gain in the ability to provide examples of inferences.
13	Misa'adah & Mariani (2021)	This study aims to describe students' mathematical problem-solving abilities supported by their metacognitive skills within a digital Project-Based Learning (PjBL) environment facilitated through the Edmodo platform. The study seeks to examine how different levels of metacognitive ability (high, medium, and low) influence both the process and the outcomes of students'	The findings show a strong relationship between the level of metacognitive ability and students' mathematical problem-solving performance. Students with high metacognitive ability were able to meet all four problem-solving indicators (understanding the problem, planning a solution, carrying out the plan, and checking the results). Students with medium metacognitive ability fulfilled three indicators but were less accurate in calculations, resulting in incorrect answers. Meanwhile, students with low

		mathematical problem solving.	metacognitive ability met only two indicators; they struggled to plan a solution and review their answers, leading to incomplete and inaccurate results. The digital PjBL learning environment supported by Edmodo was successfully implemented and served as the context in which this relationship was observed.
14	Muncer et al. (2022)	To investigate the relationship between metacognition and mathematical performance in adolescents, as well as to examine the influence of the type of metacognition measurement and the complexity of mathematical tasks.	A meta-analysis of 29 studies revealed a significant positive relationship between metacognition and mathematical performance (r = .37). This relationship was substantially stronger when metacognition was measured using online methods (such as think-aloud protocols) compared to offline questionnaires, and when the mathematical tasks were complex or required problem solving rather than merely routine procedures.
15	Hidayat et al. (2018)	To investigate the relationship between metacognition and achievement goals on mathematical modeling competence in mathematics education students, as well as	Achievement goals and metacognition were found to have a significant positive effect on mathematical modeling competence. In addition, the four dimensions of metacognition

		the mediating role of four dimensions of metacognition.	(awareness, planning, cognitive strategies, and self-checking) acted as partial positive mediators, strengthening the relationship between achievement goals and mathematical modeling competence.
16	Sunanto & Mahpudin (2023)	To develop metacognition-based instructional materials (syllabus, lesson plans, textbooks, and student worksheets) aimed at improving the mathematical problem-solving abilities of PGSD students, as well as to assess the validity and effectiveness of these materials.	The results of the study indicate that the developed metacognition-based instructional materials were deemed highly valid by content experts, media experts, and practitioners, with an average validation score of 3.3. After being implemented in the classroom, the materials proved effective in enhancing students' mathematical problem-solving abilities. The percentage of students able to solve problems according to Polya's problem-solving steps increased significantly from 34.04% in the pretest to 91.49% in the posttest. Furthermore, students showed improvements in metacognitive awareness at each stage of thinking, particularly in planning, implementing, and evaluating problem-solving

			strategies. Metacognition-based learning also contributed to increased student engagement, independence, and the development of character values such as discipline and honesty throughout the learning process.
17	Tabuyo (2024)	To determine the role of metacognition in the mathematical problem-solving performance of pre-service teachers and to identify the relationships between metacognitive awareness, metacognitive use, and problem-solving ability.	The study's findings indicate that pre-service teachers exhibited high levels of metacognitive awareness in declarative, procedural, and conditional knowledge, and frequently applied planning, monitoring, and evaluation strategies when completing mathematical tasks. Significant relationships were found between metacognitive awareness and use with mathematical problem-solving performance. The metacognitive components that most strongly influenced problem-solving scores were evaluation ($r = 0.303$, $p = 0.002$), planning ($r = 0.269$, $p = 0.006$), and declarative and procedural knowledge. Moreover, the application of evaluation and planning required more time to complete problems, indicating a

			more reflective and in-depth thinking process. The study concludes that metacognitive abilities, particularly in self-reflection and planning, are key factors in enhancing mathematical problem-solving performance.
18	Aydın & Özgeldi (2024)	To examine the role of metacognition as a mediator in the relationship between test anxiety and mathematics achievement among secondary school students.	The study revealed that although both test anxiety and metacognition individually showed significant relationships with mathematics achievement, metacognition as a whole did not serve as a significant mediator in the relationship between test anxiety and mathematics achievement. A more detailed analysis of the component elements indicated that only the cognitive knowledge component of metacognition significantly mediated the relationship between off-task behavior (a component of test anxiety) and mathematics achievement. In contrast, the cognitive regulation component did not mediate the relationship between any test anxiety components and mathematics

			achievement. Another notable finding was that although the thinking and autonomic reaction components of test anxiety had direct negative effects on mathematics achievement, these effects were not mediated by any metacognitive component.
19	Cárcamo-mansilla & Aravena-díaz (2024)	To develop and validate a questionnaire instrument for assessing metacognitive strategies used by groups of engineering students in mathematical modeling problem-solving, as well as to analyze its psychometric properties, including gender invariance.	The study successfully identified three categories of metacognitive strategies used by engineering students: planning, monitoring and regulation, and evaluation. Based on these categories, a 23-item questionnaire instrument was developed. The instrument demonstrated excellent reliability, with a Cronbach's alpha of 0.83, and construct validity, as evidenced by satisfactory results from a confirmatory factor analysis. Another key finding indicated no significant differences in the use of metacognitive strategies between male and female students, suggesting that the instrument is gender invariant.
20	Batubara (2023)	To test and compare the effectiveness of the Problem	"The study's findings indicate that students taught using the Problem

	Posing learning model versus direct instruction, and to examine the role of Field-Independent (FI) and Field-Dependent (FD) cognitive styles on mathematics learning outcomes.	Posing model achieved significantly higher mathematics learning outcomes compared to those taught through direct instruction. Additionally, students with a Field-Independent cognitive style consistently outperformed their Field-Dependent peers in mathematics. The most notable finding was the interaction between the learning model and cognitive style: Field-Independent students taught with Problem Posing achieved the highest average scores, while Field-Dependent students taught with direct instruction obtained the lowest scores. This suggests that the effectiveness of a learning model is strongly influenced by the individual cognitive characteristics of students.

Based on a review of 20 relevant articles, it was found that there is a positive and significant relationship between students' metacognitive abilities and their cognitive styles in mathematics learning. Overall, nearly all studies indicate that metacognitive abilities play a crucial role in helping students plan, monitor, and evaluate their thinking processes when solving mathematical problems. Students with a Field-Independent (FI) cognitive style tend to exhibit higher metacognitive skills compared to Field-Dependent (FD) students. This is supported by the findings of Muliawati, (2016), Sili & Angriani, (2018) serta Zakiah, (2020), which showed that FI students operate at the reflective

use level and are more consistent in planning and checking the results of problem-solving, whereas FD students tend to require external guidance to develop their metacognitive awareness and regulation.

Other studies conducted by Ahna et al. (2022), Hidajat et al. (2021), dan Limbanadi et al. (2018) urther support these findings. All three reported that students with a Field-Independent (FI) cognitive style were able to implement problem-solving strategies systematically and demonstrated strong self-evaluation skills, whereas Field-Dependent (FD) students were only able to perform some metacognitive indicators and still faced difficulties in detecting errors during the problem-solving process. Thus, cognitive style serves as a factor influencing how metacognitive abilities are applied in the context of mathematical problem solving.

The findings of Laamena & Laurens (2021) indicate that the mathematical literacy of pre-service mathematics teachers is closely related to their metacognitive characteristics. Students with high metacognitive ability tend to employ a wider range of strategies, such as sketching, analyzing problems, and reviewing solutions, whereas students with low metacognitive ability are unable to apply strategies consistently. Hidayat et al. (2018) also emphasized that metacognition plays a crucial role in strengthening the relationship between achievement goals and students' mathematical modeling competence. The four dimensions of metacognition—awareness, planning, cognitive strategies, and self-checking serve as positive mediators in enhancing students' mathematical modeling abilities.

Furthermore, a meta-analysis conducted by Muncer et al. (2022) revealed a positive and significant relationship between metacognition and mathematics performance. This relationship was stronger when metacognition was measured online using think-aloud methods compared to questionnaires. Additionally, the relationship increased when the mathematical tasks were complex and required higher-order reasoning. These findings are reinforced by the study of Tian et al. (2018), which reported that metacognitive knowledge influences mathematics learning outcomes both directly and indirectly through self-efficacy and learning motivation. Thus, in addition to cognitive skills, affective factors such as motivation and self-confidence also enhance the effectiveness of students' metacognitive abilities.

In the context of learning strategy implementation, the study by Syaiful et al. (2022) showed that the Metacognitive Learning Approach (MLA) significantly enhanced students' mathematical critical thinking skills compared to conventional instruction. Similar results were reported by Misa'adah &

Mariani (2021), who implemented Project-Based Learning (PjBL) supported by the Edmodo platform. This digital project-based learning was found to improve students' mathematical problem-solving abilities while also strengthening their metacognitive awareness. Students with high metacognitive ability were able to plan and evaluate solutions more accurately, whereas students with low metacognitive ability tended to struggle during the planning and solution-review stages.

From the educators' perspective, Daher & Hashash (2022) emphasized the importance of teachers in facilitating metacognitive processes through planning, monitoring, and evaluation activities. Teachers who create a learning environment that supports reflection and self-regulation help students develop stronger metacognitive abilities, for both FI and FD students. Hunaifi & Juandi (2023) and Kathayat (2024) further reinforced these findings by showing that the systematic implementation of metacognitive strategies can significantly enhance students' mathematical problem-solving skills.

Furthermore, Thi-nga et al. (2024) through a bibliometric analysis, found that research trends on metacognition in mathematics education have been increasing globally since 2016. Frequently studied topics include the relationship between metacognition, problem-solving ability, academic achievement, and differences in cognitive styles. This indicates that the recognition of the importance of metacognitive skills in the context of mathematics education has grown over time.

Overall, the review of the fifteen articles shows that metacognitive ability is a crucial component bridging cognitive style and success in learning mathematics. Students with a Field-Independent (FI) cognitive style excel in self-regulation and reflective thinking, whereas Field-Dependent (FD) students require more structured learning support to develop their metacognitive awareness. Therefore, designing mathematics learning that integrates metacognition-based strategies, such as the Metacognitive Learning Approach, reciprocal teaching, and digital project-based learning, represents a strategic step to enhance students' higher-order thinking skills. These findings underscore that developing metacognitive ability is not merely a supportive factor, but a fundamental foundation for fostering reflective and adaptive thinking processes in 21st-century mathematics education.

4) CONCLUSIONS

Based on the review of 20 articles, it can be concluded that there is a positive and significant relationship between students' metacognitive abilities and their cognitive styles in mathematics

learning. Students with a Field-Independent (FI) cognitive style tend to have better metacognitive regulation compared to Field-Dependent (FD) students, particularly in the aspects of planning, monitoring, and evaluating their thinking processes. Nevertheless, both cognitive styles can be optimized through the implementation of metacognition-based learning strategies, such as the Metacognitive Learning Approach, reciprocal teaching, and digital project-based learning. Therefore, metacognitive ability plays a crucial role as a foundation for developing students' reflective, adaptive, and independent thinking skills in 21st-century mathematics education.

REFERENCES

Agustiningtyas, I. T., Trapsilasiwi, D., & Yudianto, E. (2023). Students Mathematical Representation Ability in Solving Mathematics Problem Based on Field Dependent and Field Independent Cognitive Style Kemampuan Representasi Matematis Siswa dalam Menyelesaikan Masalah Matematika Ditinjau dari Gaya Kognitif Field Dependent dan Field Independent. 6(2), 187–198.

Ahna, M., Kusmaryono, I., & Aminudin, M. (2022). Kemampuan Pemecahan Masalah Matematika Siswa Kelas Vii Ditinjau Dari Gaya Kognitif Field Independent Dan Field Dependent Pada Materi Aritmatika Sosial. 2(005), 342–352.

Aydın, U., & Özgeldi, M. (2024). What' s metacognition got to do with the relationship between test anxiety and mathematics achievement? European Journal of Psychology of Education, 39(3), 2509–2529. https://doi.org/10.1007/s10212-024-00797-7

Batubara, A. A. (2023). Dependent and Independent Cognitive Style Learning Model in Mathematics Subject Outcomes. 4(2), 323–331.

Cárcamo-mansilla, N., & Aravena-díaz, M. D. (2024). Metacognitive Strategies for Mathematical Modeling with Engineering Groups of Students: Adaptation and Validation of a Questionnaire. 12, 41–55. https://doi.org/10.23947/2334-8496-2024-12-1-41-55

Daher, W., & Hashash, I. (2022). Mathematics Teachers' Encouragement of Their Students' Metacognitive Processes. 1272–1284. https://doi.org/10.3390/ejihpe12090088

Dzulfikar, A., & Herman, T. (2023). An investigation of mathematical problem-solving skills based on students' prior mathematical knowledge and cognitive style. 5(3).

Hasan, B. (2020). Proses Kognitif Siswa Field Independent dan Field Dependent Dalam Menyelesaikan. 3(4), 323–332. https://doi.org/10.22460/jpmi.v3i4.323-332

Hidajat, D., Amin, S. M., & Siswono, T. Y. E. (2021). Exploring Metacognitive Skills of University Students in Solving Mathematics Problems Based on Cognitive. 8(2).

Hidayat, R., Zulnaidi, H., & Zamri, S. N. A. S. (2018). Roles of metacognition and achievement goals in mathematical modeling competency: A structural equation modeling analysis. 1–25. https://doi.org/10.1371/journal. pone.0206211

Hunaifi, H., & Juandi, D. (2023). The effect of metacognitive strategies on mathematical problem-solving ability: A systematic literature review. January. https://doi.org/10.1063/5.0175086

Kathayat, B. (2024). Metacognitive Skills in Mathematics Learning: A Systematic Review of Literature. 2(1), 41–57. https://orcid.org/0009-0001-8331-3613

Laamena, C. M., & Laurens, T. (2021). Mathematical Literacy Ability and Metacognitive Characteristics of Mathematics Pre-Service Teacher. Infinity Journal, 10(2), 259–270. https://doi.org/10.22460/infinity.v10i2.p259-270

Limbanadi, S., Sihaloho, M., & Tangio, J. S. (2018). Deskripsi Keterampilan Metakognitif Mahasiswa yang Memiliki Gaya Kognitif Field Independent dalam Memecahkan Masalah Stoikiometri. 13, 103–107.

Misa'adah, F., & Mariani, S. (2021). Metacognition ability of grade X students in mathematical problem solving through a digital project-based learning with Edmodo. 10(3), 174–181. https://doi.org/10.15294/ujme.v10i3.53606

Muliawati, N. E. (2016). Profil Metakognisi Siswa Field-Independent Dan Field-Dependent. 2(2), 79–93.

Muncer, G., Higham, P. A., Gosling, C. J., Cortese, S., Wood-Downie, H., & Hadwin, J. A. (2022). A Meta-Analysis Investigating the Association Between Metacognition and Math Performance in Adolescence (Vol. 2012). Educational Psychology Review. https://doi.org/10.1007/s10648-021-09620-x

Pasaribu, P. B. A., Damanik, M. H., & Sitangga, F. J. (2025). Peningkatan Pemahaman Struktur Aljabar melalui Pendekatan Metakognitif. 1(2), 31–41.

Sihotang, M. R., Huda, N., & Novferma. (2024). Metacognition Analysis in Problem Solving of Field Independent and Field Dependent Students. Riemann: Research of Mathematics and Mathematics Education, 6(3), 325–334. https://doi.org/10.38114/reimann.v6i3.48

Silaban, B., & Darhim. (2023). Kemampuan Metakognisi Siswa Berdasarkan Gaya Kognitif dalam Menyelesaikan Soal PISA. Jurnal Cendekia : Jurnal Pendidikan Matematika, 7(2), 1496–1507. https://doi.org/10.31004/cendekia.v7i2.2242

Sili, I. F. K., & Angriani, D. F. (2018). Analisis Proses Metakognisi Dalam Pemecahan Masalah Matematika Ditinjau Dari Gaya Kognitif Pendahuluan Kemampuan pemecahan masalah adalah salah satu skill yang perlu diasah oleh siswa terlebih pada mata pelajaran matematika . Banyak ahli yang mengatakan b. 1(1), 57–63.

Sunanto, L., & Mahpudin. (2023). Optimizing Mathematical Problem-Solving Skills Among Student Through Metacognitive-Based Teaching Materials Development. 9(2), 327–338. https://doi.org/10.31949/jcp.v9i2.4621 p-ISSN:

Sutama, Anif, S., Prayitno, H. J., Narimo, S., Fuadi, D., Sari, D. P., & Adnan, M. (2021). Metacognition of Junior High School Students in Mathematics Problem Solving Based on Cognitive Style.

Syaiful, Huda, N., Mukminin, A., & Kamid. (2022). Using a metacognitive learning approach to enhance students' critical thinking skills through mathematics education. SN Social Sciences, 2(4), 1–26. https://doi.org/10.1007/s43545-022-00325-8

Tabuyo, A. T. (2024). Metacognition and Mathematical Problem-Solving Performance of Pre-Service Teachers. 14(4), 474–480. https://doi.org/10.47750/pegegog.14.04.45

Thi-nga, H., Thi-Binh, V., & Nguyen, T.-T. (2024). Metacognition in mathematics education: From academic chronicle to future research scenario – A bibliometric analysis with the Scopus database. 20(4).

Tian, Y., Fang, Y., & Li, J. (2018). The Effect of Metacognitive Knowledge on Mathematics Performance in Self-Regulated Learning Framework — Multiple Mediation of Self-Efficacy and Motivation. 9(December), 1–11. https://doi.org/10.3389/fpsyg.2018.02518

William, S. K., & Maat, S. M. (2020). Understanding Students' Metacognition in Mathematics Problem Solving: A Systematic Review. International Journal of Academic Research in Progressive Education and Development, 9(3), 115–127. https://doi.org/10.6007/ijarped/v9-i3/7847

Yahya, F., Suryani, E., Hermansyah, & Nurhairunnisah. (2024). Pemanfaatan Teknologi dalam Pembelajaran Berdiferensiasi Beserta Kaitannya dengan Gaya Kognitif Siswa. 1(1), 13–18.

Zakiah, N. E. (2020). Level kemampuan metakognitif siswa dalam pembelajaran matematika berdasarkan gaya kognitif. Jurnal Riset Pendidikan Matematika, 7(2), 132–147. https://doi.org/10.21831/jrpm.v7i2.30458

Zhang, J., Zhou, Y., Jing, B., Pi, Z., & Ma, H. (2024). Metacognition and Mathematical Modeling Skills: The Mediating Roles of Computational Thinking in High School Students.