Pedagonal : Jurnal Ilmiah Pendidikan
Vol. 09, No. 02, October 2025, pp. 188~200
ISSN: 2550-0406, DOI: 10.55215/pedagonal.v9i2.42

Understanding The Influence of Metacognition on Mathematical Literacy: A Literature Review

Muthya Hanifa*, Nursalam, Andi Kusumayanti, Suharti
Faculty of Tarbiyah and Teacher Training, Universitas Islam Negeri Alauddin Makassar, Gowa, Indonesia
muthyahanifa165@email.com*; nursalam_ftk@uin-alauddin.ac.id;
andi.kusumayanti@uin-alauddin.ac.id; suharti.harti@uin-alauddin.ac.id
*Corresponding author

Article Info

Article history:

Submission Jun 6, 2025
First Revised Sep 19, 2025
Accepted Oct 28, 2025
Published Oct 31, 2025

Keywords:

learning achievement
mathematical learning
mathematical literacy
metacognition
thinking strategies

ABSTRACT

Metacognition plays an important role in mathematical literacy because it helps students become aware of, monitor, and regulate their thinking processes when solving mathematical problems. With good metacognitive abilities, students can choose the right strategies, evaluate their solution steps, and correct errors to achieve a deeper conceptual understanding. This study is a narrative literature study that aims to explore the relationship between metacognitive skills and mathematical literacy in the context of learning. Literature searches were conducted through various databases (Google Scholar, Semantic Scholar, ScienceDirect, and Taylor & Francis) with publication inclusion criteria for 2016–2025. There were 40 relevant articles selected and analyzed. The results of the review show that most studies found a positive relationship between metacognition and mathematical literacy. Metacognition has been shown to support students in planning, monitoring, and evaluating thought processes when solving mathematical problems. Thus, metacognitive skills are an important foundation in improving concept understanding, problem-solving, and overall mathematical literacy. These findings confirm the importance of integrating metacognition-based learning strategies in mathematics learning design to meet 21st century challenges.

How to cite:

Hanifa, M., Nursalam, N., Kusumayanti, A., & Suharti, S. (2025). Understanding the influence of metacognition on mathematical literacy: A literature review. *Pedagonal: Jurnal Ilmiah Pendidikan, 9*(2), 188–200. https://doi.org/10.55215/pedagonal.v9i2.42

Introduction

The modern era, characterized by rapid technological progress, globalization, and the complexity of social issues, demands that every individual possess critical thinking skills, particularly in mathematical literacy. Mathematical literacy is not only limited to arithmetic skills, but mathematical literacy has a very crucial role in everyone's life, because it is related

to various daily tasks and activities (Jannah & Hayati, 2024). In addition, mathematical literacy also requires individuals to be able to apply the mathematical concepts that have been learned in solving life problems (Qoriawati et al., 2021). In the world of education, this competency is the main highlight in various global evaluations, such as the Program for International Student Assessment (PISA).

Based on the results of the 2022 Program for International Student Assessment (PISA), Indonesia was among the 81 participating countries with a participation rate of 84.9% (Febriana et al., 2024). The trend analysis of PISA results indicates that the performance of Indonesian students in reading, science, and mathematics has declined over the past few decades (OECD, 2023). This condition reflects that the mathematical literacy skills of Indonesian students remain relatively low compared to other countries within the OECD. Therefore, Indonesia continues to face significant challenges in improving students' critical thinking, problem-solving, and reflective thinking skills in mathematics.

The importance of mathematical literacy skills is taught so that students can use their mathematical knowledge in overcoming daily life problems (Qoriawati et al., 2021), starting from financial decision-making, data interpretation in the media, to understanding risks and opportunities in the field of public health. Mathematical literacy skills play a crucial role as a provision to face various challenges in the future, especially in the 21st century and in the era of disruption like today (Janah et al., 2019)

Mathematical literacy is influenced by various factors, including the individual's metacognitive awareness of mathematical knowledge that has been mastered and areas that still need development (Wati & Suendarti, 2020) This awareness includes two main aspects: (1) mastery of basic mathematical concepts, and (2) motivation to continue expanding mathematical understanding. Furthermore, this mathematical awareness facilitates the application of mathematics in real-life contexts, both for daily activities and practical problem solving (Walida et al., 2024) According to Rosita et al., (2021) metacognition refers to an individual's awareness of his or her own thought process. This metacognitive ability turns out to play an important role in problem solving, where students who master it show better performance in solving various problems and achieving optimal results (Zulfayanto et al., 2021).

According to (Febrina & Mukhidin, 2019) metacognition can be described as an individual's capacity to recognize and reflect upon the processes of thinking, learning, and processing information, as well as to monitor and regulate the cognitive activities they perform. Metaxonym helps identify the extent to which students are aware of their thinking processes, ability to evaluate understanding, and the ability to monitor their own learning progress (Faradiba et al., 2019). Flavell says that metacognition is referred to as "the process of thinking to think" (Januarti et al., 2022). In practice, metacognition encompasses two main components, namely knowledge and metacognitive skills. Metacognitive knowledge is an understanding of cognition in general and awareness of personal cognition, while metacognitive skills include an individual's ability to plan, monitor development, and observe the learning process (Saiful et al., 2020) Metacognition knowledge related to learning strategies will influence students in planning how to solve problems, as well as choosing the right strategy to solve a problem. This will involve and build relationships between the use of previous knowledge and current knowledge (Zhang & Lian, 2024).

Various studies show a positive relationship between metacognition and mathematical achievement (Kathayat, 2024; William & Maat 2020). A number of studies show that students who are able to apply metacognitive skills in solving mathematical problems tend

to experience increased mathematics learning achievement (Nirfayanti & Erna, 2021) However, there have not been many studies that explicitly link the role of metacognition in shaping mathematical literacy, especially in the context of secondary education in various developing countries.

Based on the above description, it can be seen that metacognitive skills play an important role in helping students develop their mathematical literacy abilities. However, there is still a limited number of studies that comprehensively examine the relationship between metacognition and mathematical literacy, particularly in the context of secondary education in developing countries such as Indonesia. The novelty of this research lies in the systematic analysis of forty scientific articles published between 2016 and 2025 to identify patterns, findings, and future directions of research concerning the relationship between metacognition and mathematical literacy. Thus, this study provides a significant contribution to mathematics education, both theoretically and practically. Theoretically, it broadens the understanding of how metacognitive awareness and skills serve as the foundation for building strong mathematical literacy. Practically, the results of this study are expected to serve as a basis for educators and curriculum developers to design metacognition-based learning strategies that can enhance students' critical, reflective, and problem-solving abilities in the context of 21st-century mathematics learning.

Method

This research is included in the category of literature studies with a narrative approach. The articles studied in this study were obtained through searches on various scientific databases, including: Google Scholar, Semantic Scholar, ScienceDirect, and Taylor & Francis. The keywords used in the literature search include: Metacognition, Math Literacy, Math Learning, Learning Achievement, and Thinking strategies. The literature analyzed consisted of a number of articles that fit the inclusion and exclusion criteria, namely: 1) Published literature period from 2016-2025; 2) All literature used can be accessed in full text form; 3) Literature on the influence of metacognition on mathematical literacy

The initial stage of article screening was carried out using the filtering features available on each database, based on the predetermined inclusion and exclusion criteria. Based on the search results from several academic databases Google Scholar, Semantic Scholar, ScienceDirect, and Taylor & Francis a total of 5,510 articles were identified as relevant to the selected keywords. These articles were then filtered by publication year (2016–2025), resulting in 4,651 articles that met the temporal criteria of the study. Among these, several articles were identified as duplicates across databases and subsequently removed from the list.

Articles that passed this stage were then screened through three phases, namely based on the title, abstract, and full text. The selection process began by reviewing the titles of the articles. Articles deemed relevant were downloaded, and their citations were organized using the Mendeley reference management application. Subsequently, the articles were reviewed again to ensure that no additional duplicates remained. The next stage involved examining the abstracts of each article to evaluate their alignment with the established inclusion and exclusion criteria. After completing all stages of selection, 40 articles were found to meet the criteria and were included as the primary sources for analysis in this literature study.

Data processing is carried out by extracting data into a research matrix including: author name, year of publication, research title, and research conclusion. The data were then

analyzed regarding the similarities, differences, disadvantages and advantages in each study to reach conclusions about the influence of metacognition on Mathematics literacy. The flow of literature identification process are described on the Figure 1.

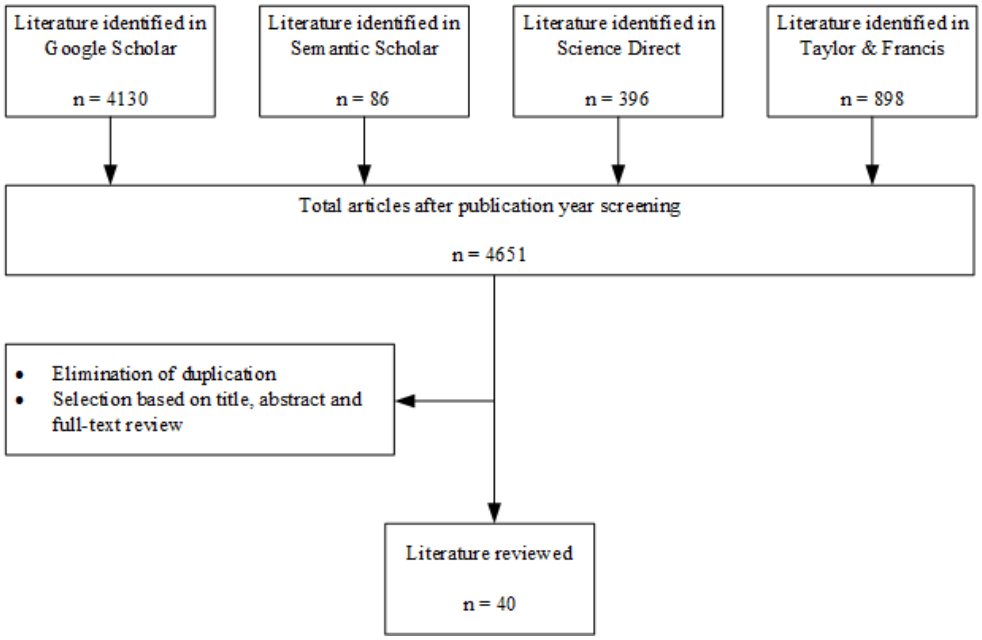

Figure 1. Flow of Literature Identification Process

Results and Discussion

This section presents the results and discussion of the literature review on metacognition in mathematical literacy, focusing on the analysis of key findings from various previous studies, as summarized in the following table. This study aims to identify how the role of metacognition influences mathematical literacy skills, the strategies students use in problem-solving, and its implications for the mathematics learning process. Thru a comparative analysis of several relevant articles (Table 1), this section also highlights current research trends, existing gaps, and future research directions related to strengthening metacognitive aspects in mathematics learning.

Table 1. Matrix Table

No	Author/Year	Title	Reserch Conclusion	Source / Database
1	(Setiawan & Dores, 2019a)	*Pengembangan Bahan Ajar Berbasis Keterampilan Metakognisi Dalam Upaya Meningkatkan Kemampuan Literasi Matematis Mahasiswa*	Metacognition skills play a significant role in improving students' mathematical literacy skills.	Semantic Scholar
2	(Cahyani et al., 2022)	*Kemampuan Literasi Matematika Siswa Dalam Memecahkan Soal Timms Konten Aljabar Ditinjau Dari Pengetahuan Metakognitif*	The level and type of metacognition greatly affect students' mathematical literacy abilities.	Google Scholar
3	(Yani T et al., 2024)	*Penerapan* Model Reciprocal Teaching *Dengan Pendekatan Metakognitif Untuk Meningkatkan Kemampuan Literasi Matematis Mahasiswa*	The metacognitive approach has a positive influence on improving students' mathematical literacy skills.	Google Scholar

4	(Walida et al., 2024)	*Kemampuan Literasi Matematika Siswa Dalam Menyelesaikan Masalah Trigonometri*	The higher and more diverse the metacognitive abilities a person has, especially in procedural and evaluative aspects, the higher the mathematical literacy ability that can be shown.	Google scholar
5	(Wati & Suendarti, 2020)	*Pengaruh Metakognisi Dan Disposisi Matematik Terhadap Literasi Matematika (Survei Pada Sma Negeri di Kota Tangerang)*	There is a correlation between metacognition and mathematical literacy	Google Scholar
6	(Setiawan & Dores, 2019b)	*Peran Keterampilan Metakognisi Terhadap Peningkatan Kemampuan Literasi Matematis Mahasiswa*	There was an increase in students' mathematical literacy skills after involving metacognition skills. A moderate contribution was made between metacognition skills in improving students' mathematical literacy skills	Google Scholar
7	(Rahmanuri et al., 2023)	*Faktor-Faktor Yang Memengaruhi Literasi Matematika:* Systematic Literature Review	Mathematical literacy is related to metacognition. This metacognition awareness can manifest students' positive tendencies towards mathematics.	Google Scholar
8	(Laamena & Laurens, 2021)	Mathematical Literacy Ability and Metacognitive Characteristics of Mathematics Pre-Service Teacher	There is a close relationship between metacognitive skills and mathematical literacy abilities in prospective mathematics teachers	Google Scholar
9	(Hidayat et al., 2021)	Analysis Of Mathematics Literacy Ability Observed from Metacognition in Learning Realistic Synectics Assisted by Schoology	Metacognition has a significant influence on students' mathematical literacy skills.	Google Scholar
10	(Rohmah & Ubaidah, 2025)	Examination Of Student's Mathematical Literacy in Solving Pisa Questions on Space and Shape Content in Terms of Metacognitive Awareness	Metacognitive awareness has a significant influence on students' mathematical literacy skills	Semantic Scholar
11	(Ovan & Nugroho, 2017)	*Analisis Kemampuan Literasi Matematika Ditinjau Dari Metakognisi Siswa Pada Model Pisa-Cps*	Students' metacognition affects students' literacy abilities	Semantic Scholar
12	(Hidayat et al., 2019)	*Analisis Kemampuan Literasi Matematika Ditinjau Dari Metakognisi Siswa Dalam Pembelajaran* Synectics *Berbantuan* Schoology	There is a relationship between literacy and metacognition	Semantic Scholar
13	(Diyarko & Waluya, 2016)	*Metakognisi Dalam Pembelajaran Inkuiri Berbantuan Lembar Kerja Mandiri* Maliling Marge	There is a relationship between improving students' metacognition which has an impact on students' mathematical literacy	Google Scholar
14	(Wahyuningsih & Waluya, 2017)	*Kemampuan Literasi Matematika Berdasarkan Metakognisi Siswa Pada Pembelajaran Cmp Berbantuan* One Class Notebook	Students' increased literacy skills will also improve students' metacognition	Google Scholar
15	(Setiawan & Dores, 2019c)	*Meningkatkan Kemampuan Literasi Matematis Mahasiswa Melalui Bahan Ajar Berbasis Keterampilan Metakognisi*	There was an increase in students' mathematical literacy skills after the implementation of learning with teaching materials based on metacognition skills	Google Scholar
16	(Setia & Rahmat, 2022)	*Analisis Pemahaman Konsep Matematis Ditinjau Dari Metakognisi*	There is a relationship between students' metacognition abilities and concept comprehension which is part of literacy	Google Scholar
17	(Smith & Mancy, 2018)	Exploring The Relationship Between Metacognitive and	Collaborative discussions can be the main trigger for the emergence of	Taylor & Francis

		Collaborative Talk During Group Mathematical Problem-Solving – What Do We Mean by Collaborative Metacognition?	metacognitive reflection in literacy in mathematical problem solving.	
18	(Ahadi et al., 2021)	Mathematical Literacy Reviewed from Student's Metacognition on the PJBL Learning with RME Approach Assisted Edmodo	The higher the student's metacognition ability, the higher the mathematical literacy ability.	Semantic Sholar
19	(Salsabila et al., 2019)	Analysis Of Mathematical Literacy on Students' Metacognition in Conic Section Material	Metacognitive abilities have a great influence on students' mathematical literacy	Google Scholar
20	(Izzati & Mahmudi, 2018)	The Influence of Metacognition in Mathematical Problem Solving	The higher the metacognition a student has, the better the math problem solving that students can do	Google Scholar
21	(William & Maat, 2020)	Understanding Students' Metacognition in Mathematics Problem Solving: A Systematic Review	Metacognition proves to be beneficial When solving math problems	Semantic Scholar
22	(Güner & Erbay, 2021)	Metacognitive Skills and Problem-Solving	Metacognitive skills have a significant influence on students' success in solving problems included in literacy	Google Scholar
23	(Sutama et al., 2021)	Metacognition of Junior High School Students in Mathematics Problem Solving Based on Cognitive Style	Students who have *a field-independent* cognitive style show high confidence and problem-solving abilities.	Semantic Scholar
24	(Desoete & De Craene, 2019)	Metacognition and Mathematics Education: An Overview	Metacognition is an important predictor of mathematical performance**.** Many studies in this article show that metacognitive abilities are positively correlated with the mathematical achievement of students of various educational levels.	Google Scholar
25	(Alzahrani, 2021)	Metacognition And Its Role in Mathematics Learning: An Exploration of the Perceptions of a Teacher and Students in a Secondary School	Metacognition must be prioritized to increase students' awareness of the learning process. This is because conscious reflection allows students to develop the ability to choose the most appropriate strategies to learn concepts and solve mathematical problems	Google Scholar
26	(Siagian et al., 2019)	Development Of Learning Materials Oriented on Problem-Based Learning Model to Improve Students' Mathematical Problem-Solving Ability and Metacognition Ability	Students' mathematical problem-solving skills and metacognition skills improved after learning using PBL teaching materials	Semantic Scholar
27	(Jagals & Van Der Walt, 2016)	Enabling Metacognitive Skills for Mathematics Problem Solving: A Collective Case Study of Metacognitive Reflection and Awareness	Metacognitive reflection is essential in solving mathematical problems. Reflection on the thought process helps students become more aware of how they think and act while solving math problems, especially non-routine ones.	Taylor & Francis
28	(Kuzle, 2018)	Assessing Metacognition of Grade 2 And Grade 4 Students Using an Adaptation of Multi-Method Interview Approach During Mathematics Problem-Solving	Metacognition plays an important role in improving students' math skills, especially in problem solving	Google Scholar
29	(López-Vargas et al., 2017)	Students' Metacognition and Cognitive Style and Their Effect on Cognitive Load And Learning Achievement	The application of metacognitive scaffolding in computer-based learning has been shown to significantly improve student learning achievement and lower cognitive load (intrinsic and extrinsic).	Semantic Scholar

30	(Bishara & Kaplan, 2018)	The Relationship of Locus of Control and Metacognitive Knowledge of Math with Math Achievements	The use of metacognitive knowledge improves mathematical achievement and mediates the relationship between internal locus of control and learning outcomes, so metacognitive training is effective in improving student achievement.	Taylor & Francis
31	(Ajisuksmo & Saputri, 2017)	The Influence of Attitudes Towards Mathematics, and Metacognitive Awareness on Mathematics Achievements	Positive attitudes towards mathematics have a significant effect on learning achievement, whereas metacognitive awareness does not show a significant influence.	Google Scholar
32	(Gaylo & Dales, 2017)	Metacognitive Strategies: Their Effects on Students' Academic Achievement and Engagement in Mathematics	*Metacognitive strategies* are effective in improving students' math achievement and are closely related to their involvement in learning.	Semantic Scholar
33	(Toraman et al., 2020)	Analysis Of the Relationships Between Mathematics Achievement, Reflective Thinking of Problem Solving and Metacognitive Awareness	Metacognitive awareness and reflective thinking have been shown to significantly improve students' mathematics learning achievement.	Google Scholar
34	(Buzzai et al., 2020)	The Relationship Between Mathematical Achievement, Mathematical Anxiety, Perfectionism and Metacognitive Abilities in Italian Students	Metacognitive abilities such as attitudes towards math, beliefs, and control in solving problems significantly improve math achievement.	Google Scholar
35	(Su et al., 2016)	Mathematical Teaching Strategies: Pathways To Critical Thinking and Metacognition	Mathematics learning based on metacognition and critical thinking is effective in increasing students' reasoning, reflection, and independence in solving problems.	Google Scholar
36	(Amal & Mahmudi, 2020)	Enhancing Students' Self-Efficacy Through Metacognitive Strategies in Learning Mathematics	Metacognition strategies have a significant role in improving students' self-efficacy and learning achievement in mathematics learning.	Semantic Scholar
37	(Salam et al., 2020)	Strategies Of Metacognition Based on Behaviorual Learning to Improve Metacognition Awareness and Mathematics Ability of Students	The results of metacognition awareness in mathematics education through behavior-based metacognition strategies can be increased	Google Scholar
38	(Albab et al., 2020)	Metacognition Skills and Higher Order Thinking Skills (Hots) In Mathematics	Metacognitive skills have a significant effect on the higher-level thinking ability (HOTS) of mathematics students, with the greatest contribution coming from the aspect of self-regulation	Google Scholar
39	(Özkubat & Özmen, 2020)	Investigation Of Effects of Cognitive Strategies and Metacognitive Functions on Mathematical Problem solving Performance of Students with or Without Learning Disabilities	Metacognitive strategies are consistently the main predictors in improving the math problem-solving performance of students, both those who have learning difficulties and those who perform average or low	Semantic Scholar
40	(Ansari et al., 2021)	Exploring Students' Learning Strategies and Self-Regulated Learning in Solving Mathematical Higher-Order Thinking Problems	Metacognition-based learning strategies, especially elaboration and organization, have proven to be effective in helping students better understand and solve HOTS math problems.	Semantic Scholar

After analyzing 40 relevant studies, substantial evidence indicates a positive link between metacognitive abilities and mathematical literacy. The literature review reveals that the majority of research highlights the crucial role of metacognitive abilities in enhancing mathematical comprehension, facilitating problem-solving, and attaining improved learning outcomes.

A total of 35 out of 40 articles explicitly stated that metacognition makes a significant contribution to improving mathematical literacy. For example, research by Setiawan & Dores (2019) and Yani T et al. (2024) shows that metacognition-based learning strategies consistently improve students' mathematical literacy. Meanwhile, studies by Wati & Suendarti (2020) and Walida et al. (2024) confirm a strong correlation between metacognitive awareness and the ability to apply mathematics in real-life contexts.

These findings indicate that metacognitive awareness is not merely an additional factor, but rather the main mechanism in the formation of mathematical literacy. This result is consistent with the theory, which states that metacognition involves the ability to plan, monitor, and evaluate one's thinking processes three essential components in solving mathematical problems reflectively (Ozturk, 2017). Similarly, William & Maat (2020) assert that students with high metacognitive abilities are able to identify errors and adjust their problem-solving strategies, leading to a more meaningful understanding of mathematical concepts.

Furthermore, when viewed from a learning approach perspective, most studies highlight the effectiveness of strategies that integrate reflective and self-regulatory activities, such as reciprocal teaching and project-based learning. These strategies have been proven to stimulate higher-order thinking processes and increase student engagement in learning (Ahadi et al., 2021; Yani T et al., 2024). This suggests that improving mathematical literacy does not rely solely on content mastery, but also on the extent to which students can manage their own thinking processes during learning.

However, differences in findings reported by some studies, such as Ajisuksmo & Saputri (2017), show that the influence of metacognition on mathematical literacy may vary depending on the learning context and student characteristics. Factors such as motivation, cognitive style, and learning environment support can strengthen or weaken the metacognitive effect on literacy achievement. Therefore, the implementation of metacognition-based strategies should be adapted to classroom conditions and student characteristics to achieve optimal results.

The study also highlights the importance of learning approaches that integrate metacognitive strategies, such as reciprocal teaching, project-based learning, and the use of digital platforms like Schoology and Edmodo, which have been proven to enhance students' mathematical literacy skills. For instance, Yani T et al., (2024) demonstrated that the implementation of the reciprocal teaching model with a metacognitive approach significantly improved students' mathematical literacy. Similarly, Ahadi et al., (2021), found that project-based learning based on Realistic Mathematics Education (RME) assisted by Edmodo effectively strengthened student engagement and enhanced metacognitive effectiveness. In addition, Hidayat et al., (2019) emphasized that the use of the digital platform Schoology in Synectic's-based learning had a positive impact on improving students' mathematical literacy and metacognitive awareness. Therefore, the integration of metacognition-based learning strategies through innovative approaches and digital technology utilization serves as an effective way to strengthen students' mathematical literacy skills.

Thus, it can be concluded that metacognition is not only a supporting factor, but an important foundation in building a complete mathematical literacy. The results of this review reinforce the urgency of integrating metacognitive skills in mathematics learning design, especially to prepare students for the challenges of the 21st century.

Conclusion

From the review of 40 relevant articles, the evidence suggests that metacognitive skills play a notable role in the advancement of mathematical literacy. Individuals who have awareness and control over their thought processes tend to be better able to understand mathematical concepts in depth, apply them in real contexts, and solve mathematical problems effectively. These findings confirm that metacognition is not only a supporting factor, but is an essential component in forming robust mathematical literacy. Therefore, it is important to integrate metacognition-based learning strategies in mathematics instruction, both through direct approaches such as reciprocal teaching and project-based learning, and through the use of technology. Furthermore, future research is recommended to explore more deeply the role of metacognition in enhancing mathematical literacy across various educational levels and contexts.

References

Ahadi, F., Asikin, M., & Wardono, W. (2021). Mathematical literacy reviewed from students' metacognition on the PJBL learning with RME approach assisted by Edmodo. *Unnes Journal of Mathematics Education Research, 10*(A), 59–67.

Ajisuksmo, C. R. P., & Saputri, G. R. (2017). The influence of attitudes towards mathematics and metacognitive awareness on mathematics achievements. *Creative Education, 8*(3), 486–497.

Albab, U., Budiyono, & Indriati, D. (2020). Metacognition skills and higher order thinking skills (HOTS) in mathematics. *Journal of Physics: Conference Series, 1613*(1), 012917.

Alzahrani, K. S. (2021). Metacognition and its role in mathematics learning: An exploration of the perceptions of a teacher and students in a secondary school. *International Electronic Journal of Mathematics Education, 12*(3), 521–537.

Amal, M. F., & Mahmudi, A. (2020). Enhancing students' self-efficacy through metacognitive strategies in learning mathematics. *Journal of Physics: Conference Series, 1613*(1), 012003.

Ansari, B. I., Saleh, M., Nurhaidah, & Taufiq. (2021). Exploring students' learning strategies and self-regulated learning in solving mathematical higher-order thinking problems. *European Journal of Educational Research, 10*(2), 743–756.

Bishara, S., & Kaplan, S. (2018). The relationship of locus of control and metacognitive knowledge of math with math achievements. *International Journal of Disability, Development and Education, 65*(6), 631–648.

Buzzai, C., Filippello, P., Puglisi, B., Mafodda, A. V., & Sorrenti, L. (2020). The relationship between mathematical achievement, mathematical anxiety, perfectionism, and metacognitive abilities in Italian students. *Mediterranean Journal of Clinical Psychology, 8*(3), 1–18.

Cahyani, L. N., Shodiq, L. J., & Agustin, D. R. (2022). Kemampuan literasi matematika siswa dalam memecahkan soal TIMSS konten aljabar ditinjau dari pengetahuan metakognitif. *Journal Focus Action of Research Mathematic (Factor M), 5*(1), 31–51.

Desoete, A., & De Craene, B. (2019). Metacognition and mathematics education: An overview. *ZDM – Mathematics Education, 51*(4), 565–575.

Diyarko, & Waluya, S. B. (2016). Analisis kemampuan literasi matematika ditinjau dari metakognisi dalam pembelajaran inkuiri berbantuan lembar kerja mandiri *Mailing Merge*. *Unnes Journal of Mathematics Education Research, 5*(1), 70–80.

Faradiba, S. S., Sa'dijah, C., Parta, I. N., & Rahardjo, S. (2019). Looking without seeing: The role of metacognitive blindness of students with high math anxiety. *International Journal of Cognitive Research in Science, Engineering and Education, 7*(2), 53–65.

Febriana, I., Ameliya, A., Napitu, C. A. S., Purba, M. A., & Piliang, Y. K. A. (2024). Analisis pengaruh literasi membaca terhadap kemampuan matematika di tinjau dari data PISA 2022. *Algoritma: Jurnal Matematika, Ilmu pengetahuan Alam, Kebumian dan Angkasa*, *2*(4), 230-235.

Febrina, E., & Mukhidin. (2019). Metakognitif sebagai keterampilan berpikir tingkat tinggi pada pembelajaran abad 21. *Jurnal Ilmu Pendidikan dan Pengajaran, 6*(1), 25–32.

Gaylo, D. N., & Dales, Z. I. (2017). Metacognitive strategies: Their effects on students' academic achievement and engagement in mathematics. *World Review of Business Research, 7*(2), 35–55.

Güner, P., & Erbay, H. N. (2021). Metacognitive skills and problem-solving. *International Journal of Research in Education and Science, 7*(3), 715–734.

Hidayat, N. Y., Wardono, W., & Rusilowati, A. (2021). Analysis of mathematics literacy ability observed from metacognition in learning realistic synectics assisted by Schoology. *Unnes Journal of Mathematics Education Research, 10*(1), 41–47.

Hidayat, Y. N., Wardono, W., & Rusilowati, A. (2019). Analisis kemampuan literasi matematika ditinjau dari metakognisi siswa dalam pembelajaran synectics berbantuan Schoology. *Prisma, Prosiding Seminar Nasional Matematika, 2*(2), 911–916.

Izzati, L. R., & Mahmudi, A. (2018). The influence of metacognition in mathematical problem solving. *Journal of Physics: Conference Series, 1097*(1), 012153.

Jagals, D., & Van Der Walt, M. (2016). Enabling metacognitive skills for mathematics problem solving: A collective case study of metacognitive reflection and awareness. *African Journal of Research in Mathematics, Science and Technology Education, 20*(2), 154–164.

Janah, S. R., Suyitno, H., & Rosyida, I. (2019). Pentingnya literasi matematika dan berpikir kritis matematis dalam menghadapi abad ke-21. *PRISMA, Prosiding Seminar Nasional Matematika, 2*, 905–910.

Jannah, M., & Hayati, M. (2024). Pentingnya kemampuan literasi matematika dalam pembelajaran matematika. *Griya Journal of Mathematics Education and Application, 4*(1), 40–54.

Januarti, A. N., Windyariani, S., & Juhanda, A. (2022). Pengaruh self regulation learning terhadap pengetahuan metakognitif peserta didik kelas XI materi sistem ekskresi. *BIODIK: Jurnal Ilmiah Pendidikan Biologi, 8*(3), 91–98.

Kathayat, B. (2024). Metacognitive skills in mathematics learning: A systematic review of literature. *Journal of Musikot Campus, 2*(1), 41–57.

Kuzle, A. (2018). Assessing metacognition of grade 2 and grade 4 students using an adaptation of multi-method interview approach during mathematics problem-solving. *Mathematics Education Research Journal, 30*, 185–207.

Laamena, C. M., & Laurens, T. (2021). Mathematical literacy ability and metacognitive characteristics of mathematics pre-service teachers. *Infinity Journal of Mathematics Education, 10*(2), 259–270.

López-Vargas, O., Ibáñez-Ibáñez, J., & Racines-Prada, O. (2017). Students' metacognition and cognitive style and their effect on cognitive load and learning achievement. *Educational Technology and Society, 20*(3), 145–157.

Nirfayanti, & Erna. (2021). Pengaruh kemampuan metakognisi terhadap hasil belajar matematika siswa SMA. *Mathline: Jurnal Matematika dan Pendidikan Matematika, 6*(1), 109–123.

OECD. (2023). *OECD Economic Outlook, Volume 2023, Issue 1* (No. 113). OECD Publishing.

Ovan, O., & Nugroho, S. E. (2017). Analisis kemampuan literasi matematika ditinjau dari metakognisi siswa pada model PISA-CPS. *Unnes Journal of Mathematics Education Research, 6*(1), 96–102.

Özkubat, U., & Özmen, E. R. (2020). Investigation of effects of cognitive strategies and metacognitive functions on mathematical problem-solving performance of students with or without learning disabilities. *International Electronic Journal of Elementary Education, 13*(4), 443–456.

Ozturk, N. (2017). Assessing metacognition: Theory and practices. *International Journal of Assessment Tools in Education*, *4*(2), 134-148.

Qoriawati, R., Sulistyawati, I., & Yustitia, V. (2021). Literasi matematika siswa sekolah dasar ditinjau dari gaya kognitif field independent. *UNION: Jurnal Ilmiah Pendidikan Matematika, 9*(2), 215–225.

Rahmanuri, A., Winarni, R., & Surya, A. (2023). Faktor-faktor yang memengaruhi literasi matematika: *Systematic literature review*. *Didaktika Dwija Indria, 11*(6), 1–6.

Rohmah, E. M., & Ubaidah, N. (2025). Examination of students' mathematical literacy in solving PISA questions on space and shape content in terms of metacognitive awareness. *Union: Jurnal Ilmiah Pendidikan Matematika, 13*(1), 182–199.

Rosita, I., Syamsuri, S., Nindiasari, H., & Sukirwan, S. (2021). Analisis keterampilan metakognisi siswa SMP dengan gaya kognitif reflektif-impulsif dalam pemecahan masalah geometri. *Symmetry: Pasundan Journal of Research in Mathematics Learning and Education, 6*(2), 148–166.

Saiful, S., Hobri, H., & Tohir, M. (2020). Analisis metakognisi siswa berbasis *lesson study for learning community (LSLC)* ditinjau dari gaya kognitif. *Alifmatika: Jurnal Pendidikan dan Pembelajaran Matematika, 2*(1), 73–91.

Salam, M., Misu, L., Rahim, U., Hindaryatiningsih, N., & Ghani, A. R. A. (2020). Strategies of metacognition based on behavioural learning to improve metacognition awareness and mathematics ability of students. *International Journal of Instruction, 13*(2), 61–72.

Salsabila, E., Rahayu, W., Kharis, S. A., & Putri, A. (2019). Analysis of mathematical literacy on students' metacognition in conic section material. *Journal of Physics: Conference Series, 1417*(1).

Setia, Y. F., & Rahmat, T. (2022). Analisis pemahaman konsep matematis ditinjau dari metakognisi. *Jurnal Pendidikan Tambusai, 6*(2), 16779–16788.

Setiawan, B., & Dores, O. J. (2019a). Pengembangan bahan ajar berbasis keterampilan metakognisi dalam upaya meningkatkan kemampuan literasi matematis mahasiswa. *JPMI (Jurnal Pendidikan Matematika Indonesia)*, *4*(2), 68–72.

Setiawan, B., & Dores, O. J. (2019b). Peran keterampilan metakognisi terhadap peningkatan kemampuan literasi matematis mahasiswa. *Prosiding Seminar Nasional Pendidikan Mipa Dan Teknologi II*, *1*(1), 350–359.

Setiawan, B., & Dores, O. J. (2019c). Meningkatkan kemampuan literasi matematis mahasiswa melalui bahan ajar berbasis keterampilan metakognisi. *J-PiMat: Jurnal Pendidikan Matematika*, *1*(2), 91–99.

Siagian, M. V., Saragih, S., & Sinaga, B. (2019). Development of learning materials oriented on problem-based learning model to improve students' mathematical problem solving ability and metacognition ability. *International Electronic Journal Of Mathematics Education*, *14*(2), 331–340.

Smith, J. M., & Mancy, R. (2018). Exploring the relationship between metacognitive and collaborative talk during group mathematical problem-solving–what do we mean by collaborative metacognition? *Research in Mathematics Education*, *20*(1), 14–36.

Su, H. F. H., Ricci, F. A., & Mnatsakanian, M. (2016). Mathematical teaching strategies: Pathways to critical thinking and metacognition. *International Journal of Research in Education and Science*, *2*(1), 190–200.

Sutama, S., 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. *Asian Journal of University Education*, *17*(1), 134–144.

Toraman, O., Orakcı, Ş., & Aktan, O. (2020). Analysis of the relationships between mathematics achievement, reflective thinking of problem solving and metacognitive awareness. *International Journal of Progressive Education*, *16*(2), 72–90.

Wahyuningsih, P., & Waluya, S. B. (2017). Kemampuan literasi matematika berdasarkan metakognisi siswa pada pembelajaran CMP berbantuan onenote class notebook. *Unnes Journal of Mathematics Education Research*, *6*(1), 1–29.

Walida, S. E., Alifiani, A., Sari, F. K., Ilmi, Y. I. N., Khairunnisa, G. F., & Chasanah, A. (2024). Kemampuan literasi matematika siswa dalam menyelesaikan masalah trigonometri. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, *8*(2), 971–985.

Wati, L. K., & Suendarti, M. (2020). Pengaruh metakognisi dan disposisi matematik terhadap literasi matematika (Survei pada SMA Negeri di Kota Tangerang). *Jurnal Pendidikan MIPA*, *3*(3), 1–13.

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.

Yani T, A., Meldi, N. F., Winarji, A., Novianti, M., & Sumarno, M. (2024). Penerapan model reciprocal teaching dengan pendekatan metakognitif untuk meningkatkan kemampuan literasi matematis mahasiswa. *Jurnal Pendidikan Informatika dan Sains*, *13*(2), 130–140.

Zhang, W., & Lian, R. (2024). The impact of reading metacognitive strategies on mathematics learning efficiency and performance: An analysis using PISA 2018 data in China. *Acta Psychologica*, *246*, 104247.

Zulfayanto, I., Faradiba, S. S., & Alifiani. (2021). Kegagalan metakognitif peserta didik kelas VII SMPN 1 Moyo Utara dalam menyelesaikan masalah aritmatika sosial. *Jurnal Penelitian, Pendidikan, Dan Pengajaran*, *16*(12), 196–209.