

STUDENTS' MATHEMATICS LEARNING DIFFICULTIES IN TERMS OF METACOGNITIVE ABILITY: A SYSTEMATIC LITERATURE REVIEW

Husnul Khatimah Rusyid¹, Dadang Juandi²
Pendidikan Matematika^{1,2}, Fakultas Pendidikan Matematika dan Ilmu
Pengetahuan Alam^{1,2}, Universitas Pendidikan Indonesia^{1,2}
husnul.khatimah.r@upi.edu¹, dadang.juandi@upi.edu²

Abstract

Mathematics learning difficulties are an important aspect to be addressed in learning. By developing students' metacognition skills, learning difficulties can be minimized. Many studies have been conducted related to students' mathematics learning difficulties in terms of metacognition abilities. The purpose of this study is to determine the heterogeneity of research based on the year of publication, level of education, research methods used, demographics of the research country, and the type of learning difficulties experienced by students seen from the indicators of metacognition ability. The method used in this research is Systematic Literature Review (SLR) based on a quantitative descriptive approach using the PRISMA protocol. The results showed that the analysis of students' mathematics learning difficulties in terms of metacognition ability was most widely published in 2021 at the junior high school level. Indonesia dominates research with similar topics and uses qualitative research methods. Most of the mathematics learning difficulties experienced by students are seen from the classification of metacognition ability categories, namely classifying objects based on the requirements for forming concepts, identifying the properties of operations or mathematical concepts and symbols.

Keywords: Learning Difficulties, Metacognition, Mathematics, Systematic Literature Review

A. Introduction

Learning difficulties are a common factor that occurs in classroom learning. Learning difficulties are defined as students' difficulties in receiving or absorbing lessons at school (Amallia & Unaenah, 2018). Learning difficulties are also defined as a failure to achieve learning objectives, characterized by not mastering the minimum level of mastery, not being able to achieve appropriate achievements, not being able to realize developmental tasks, and not being able to achieve the level of mastery required as a prerequisite for continuing to learn at the next level (Mulyadi, 2010; Subini, 2013; Suwanto, 2013). Learning difficulties usually cannot be

identified until students experience failure in completing the academic tasks they must perform (Reid in Martini, 2015). Furthermore, Blassic & Jones (Irham & Wiyani, 2013) state that learning difficulties experienced by students are indicated by the gap or distance between expected academic achievement. Individuals who experience learning difficulties are those with normal intelligence, but show one or more important deficiencies in the learning process, either perception, memory, attention, or motor function.

Mathematics is an abstract science that is very important for students to learn for its use in everyday life. However, most students have negative perceptions that cause difficulties in learning mathematics (Harahap & Syarifah, 2015). Mathematics learning difficulties are activities characterized by students' inability to understand mathematical processes, difficulty working on tasks involving numbers or mathematical symbols (Fritz et al., 2019; Khin Eng & Sai Hoe, 2021). Thus, learning difficulties in mathematics are related to explaining concepts, mentioning examples and non-examples, understanding concepts, using symbols, calculating (counting), applying concepts, and understanding problems. In line with this, (Kereh & Sabandar, 2013) revealed that learning difficulties in mathematics material can be interpreted as students' difficulties which can be revealed from the patterns of errors made by students in working on problems.

According to Cooney (Pramesti & Prasetya, 2021) and Soejono (Nugraha et al., 2015), students' mathematics learning difficulties are classified into three types of difficulties with the following criteria: (1) students' difficulties in using mathematical concepts, namely the inability to remember technical names, state the meaning of terms that represent certain concepts, and remember one or more conditions related to an object, (2) students' difficulties in using mathematical principles are related to the inability to carry out discovery activities about mathematical calculations or operations, abstract patterns, and are unable to state the meaning of the principles used, and (3) students' difficulties in solving verbal problems which are largely determined by students' knowledge and ability to use concepts and principles. The cause of student learning difficulties is based on errors in understanding concepts (Gunadi et al., 2022; Klorina & Juandi, 2022). Mathematics learning difficulties that occur will lead students to the achievement

of suboptimal learning outcomes and poor learning achievement so that a structured and controlled activity process is needed. Students who are able to manage their cognitive activities well may be able to handle tasks and solve problems well. This is referred to as metacognition (Santrock, 2007).

Metacognition is defined as thinking about thinking or knowledge of one's thinking process. (Taccasau, 2008) defines metacognition as part of planning, monitoring, and evaluating the learning process as well as awareness and control of the learning process. Metacognition plays an important role in learning activities and improving students' learning abilities. Metacognition includes declarative knowledge, procedural knowledge, and conditional knowledge. Declarative knowledge is knowledge about oneself as a learner and knowledge about learning strategies, skills and resources needed for learning. Procedural knowledge is knowledge about how to use everything that has been known in declarative knowledge in learning activities. Conditional knowledge is knowledge about when to use a procedure, skill, or strategy and when these things are not used, why a procedure takes place and under what conditions it takes place, and why a procedure is better than other procedures. With the metacognition skills possessed by students, it will minimize the learning difficulties experienced, especially in mathematics.

There have been many studies conducted on mathematics learning difficulties in terms of metacognition abilities, including (Bessoondyal, 2017; Boyle et al., 2016; Ilmi et al., 2022; Ode & Iriana, 2020; Rukhmana, 2021) and several other studies. Therefore, to get complete information and appropriate data, it is necessary to conduct a systematic literature review to find out an in-depth description of research on mathematics learning difficulties in terms of metacognition skills throughout the country. Therefore, this study uses a systematic literature review method which aims to find, select, evaluate, and interpret the results of primary research that has been conducted (Barricelli et al., 2019). Systematic literature review is used to find out how the heterogeneity of research related to the analysis of mathematics learning difficulties in terms of metacognition abilities based on the year of publication, education level, research methods used, research demographics, and analysis of metacognition ability indicators. Thus, the researcher asked several relevant questions as follows: (1) How is the description of the research results of

mathematics learning difficulties in terms of metacognition ability based on the year of publication? (2) How is the description of the research results of mathematics learning difficulties in terms of metacognition ability based on the level of education? (3) How is the description of the research results of mathematics learning difficulties in terms of metacognition ability based on the research method used? (4) How is the description of the research results of mathematics learning difficulties in terms of metacognition ability based on research demographics? (5) How is the description of the results of research on mathematics learning difficulties in terms of metacognition abilities based on the co-occurrence of the author's keywords? (6) What are the mathematics learning difficulties experienced by students seen from the indicators of metacognition ability?

B. Methods

Research Design

This research design is a Systematic Literature Review (SLR). Systematic Literature Review is a type of research conducted to systematically synthesize existing research evidence, critical review, and synthesis of research results to answer a question (Kofod-petersen, 2018). This method is survey-based with a quantitative descriptive approach. The survey was conducted on primary data in the form of basic research results on the analysis of mathematics learning difficulties in terms of metacognition abilities. The research stages include data collection, data analysis, and conclusion (Juandi & Tamur, 2020). Data were collected using keywords in Bahasa, namely "kesulitan belajar matematika"; "kemampuan metakognisi"; and "siswa" and English, namely "learning disabilities"; "learning difficulties"; "mathematics"; and "student" published in national and international journals with Scopus, Google Scholar, and ERIC databases. Next, all articles found were extracted and only relevant articles that met the inclusion criteria were included in the analysis stage.

Inclusion Criteria

To obtain data in accordance with the research objectives, the following inclusion criteria are required: (1) The study discusses learning difficulties in terms of metacognition skills; (2) The study is conducted in the form of an article or conference paper; (3) The research sample must consist of elementary school to

high school education levels; (4) The study must contain the approach or method used; (5) The research study is from 2005 to 2023; and (6) The study is indexed by Scopus, Google Scholar, and ERIC. Primary studies that do not meet the inclusion criteria will be excluded during the systematic review process.

Research Instruments

The research instrument is an observation related to inclusion criteria based on the type of study, education level, journal indexer, research year and research method used. The writing procedure used is the PRISMA procedure (Preferred Reporting Items for Systematic Reviews and Meta-Analyses). The primary study selection process is carried out through four stages that refer to PRISMA, namely identification, screening, eligibility, and inclusion (Juandi & Tamur, 2020; Liberati et al., 2009).

Population and Sample

The population in this study is all research on students' mathematics learning difficulties in terms of metacognition skills published in Scopus, Google Scholar, and ERIC indexed journals. Based on a search using a search engine assisted by Publish or Perish 8, 17 articles were found consisting of 6 Scopus indexed articles, 9 Google Scholar indexed articles, and 2 ERIC indexed articles. The data that has been collected is then analyzed using VosViewer and Microsoft excel applications.

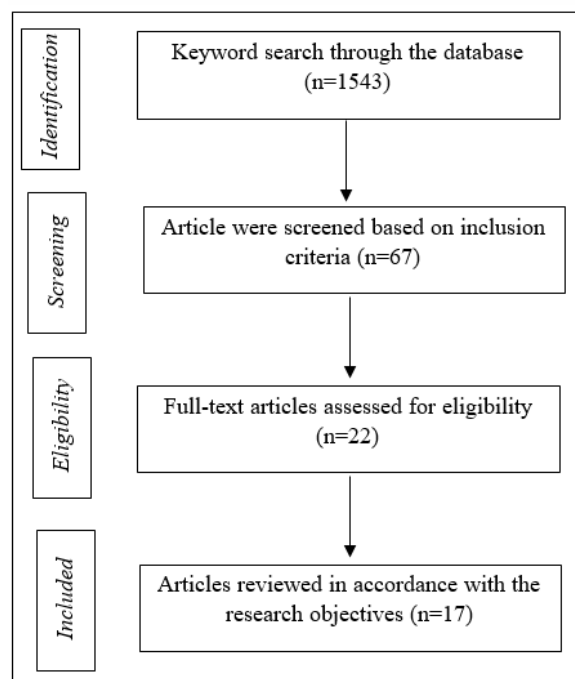


Figure 1. PRISMA diagram

C. Results and Discussion

The research results are presented in five sections including year of publication, level of education, research methods used, research demographics, and learning difficulties seen from indicators of metacognitive abilities. The results of the analysis based on these five criteria are presented in the table below:

Table 1. Research of Article Analysis Based on Inclusion Criteria

Characteristic Study	Criteria	Frequency
Year of Publication	2005-2010	1
	2011-2015	1
	2016-2020	6
	2021	6
	2022	2
	2023	1
Education Level	Primary School	5
	Junior High School	9
	Senior High School	3
Research Method	Quantitative	4
	Qualitative	10
	Mix-Method	3
Country Demographics	Indonesia	9
	United States	4
	Africa	1
	Italy	1
	Turkey	1
	Greece	1
Sample Size	≥ 30	10
	< 30	7

Study Based on Year of Publication

In 2000-2023, several studies have been conducted on students' mathematics learning difficulties in terms of metacognition ability. The following is presented the distribution of research that has been conducted based on the year of publication as follows:

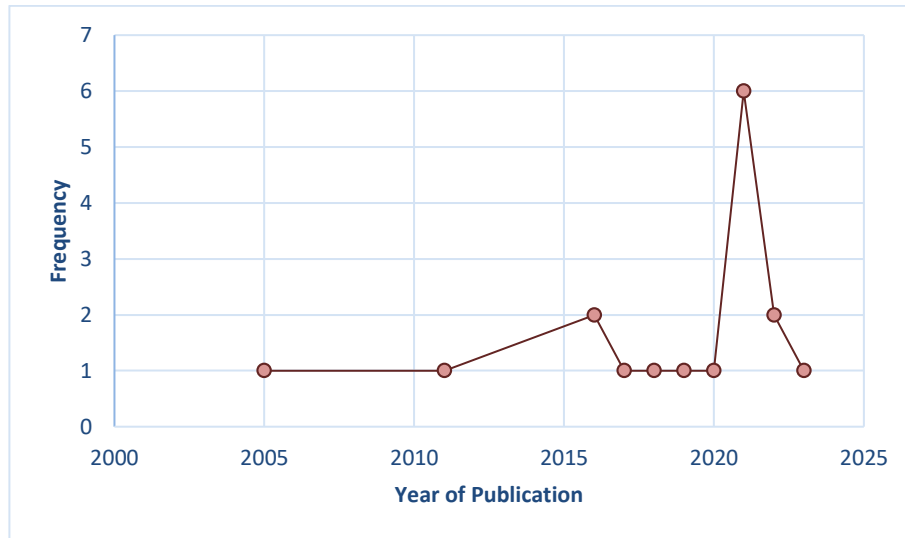


Figure 2. Research Distribution Based on Year of Publication

Based on Figure 1, it can be seen that the number of studies on mathematics learning difficulties in terms of metacognition ability fluctuates from 2005 to 2023. Most of the research was conducted in 2021 with a total of 6 published articles. Meanwhile, from 2005-2011 and 2017-2020, there was only 1 published article each. This shows that there are still few studies conducted on mathematics learning difficulties experienced by students and how students solve them using their metacognitive abilities. In line with research conducted (Puspitasari et al., 2023) that metacognition skills will affect students' mathematical problem solving so it is necessary to analyze the learning difficulties experienced.

Study Based on Education Level

The following presents the primary study based on the level of education from elementary to high school which can be seen in Figure 2.

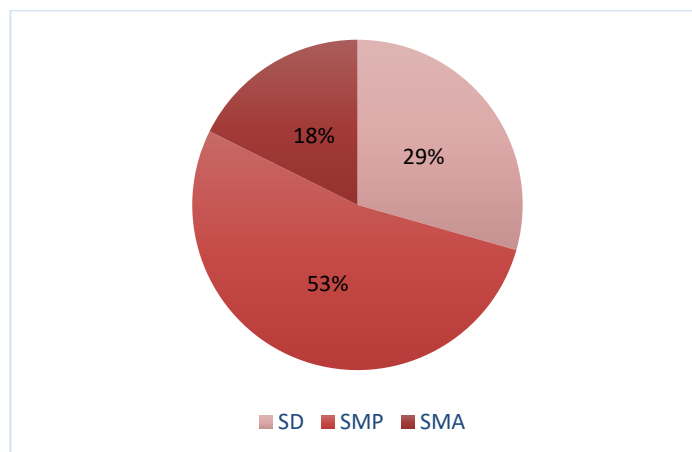


Figure 2. Distribution of Research Based on Education Level

Based on Figure 2, it can be concluded that research on students' mathematics learning difficulties in terms of metacognition ability is mostly conducted at the junior high school level where there are 9 studies that have been conducted. While at the elementary level there are 5 studies and the least at the high school level where there are only 3 studies. This is because students at the secondary level tend to be trained to master various kinds of mathematical abilities, such as problem solving and concept understanding (Juandi, 2021). Thus, students are aware of their cognitive abilities and can manage their abilities well.

Study Based on Country Demographics

Research on students' mathematics learning difficulties in terms of metacognition skills has also been conducted in several countries. Below is the demographic distribution of research countries which can be seen in Figure 3.

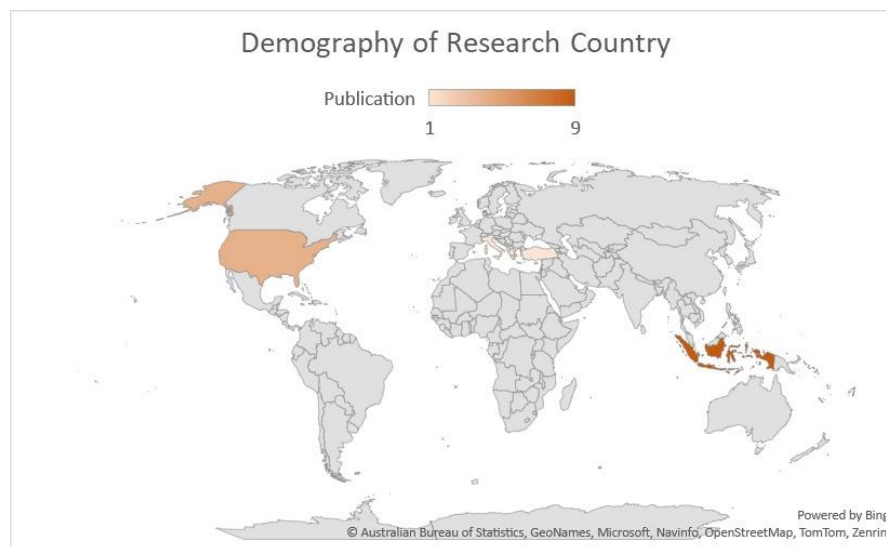


Figure 3. Research Based on Country Demographics

Based on Figure 3, it can be concluded that there are 9 studies of mathematics learning difficulties in terms of metacognition skills conducted in Indonesia and the largest number of studies among other countries, 4 studies conducted in the United States, while in Africa, Italy, Turkey, and Greece there is 1 study each that has been done. In general, there are 9 studies conducted in the Asian continent, 3 studies in the European continent, 4 studies in the American continent, and at least 1 study in the African continent.

Study Based on Research Methods

Furthermore, research on mathematics learning difficulties in terms of metacognition ability has been conducted using various methods. The distribution of research based on the research methods used can be seen in Figure 4.

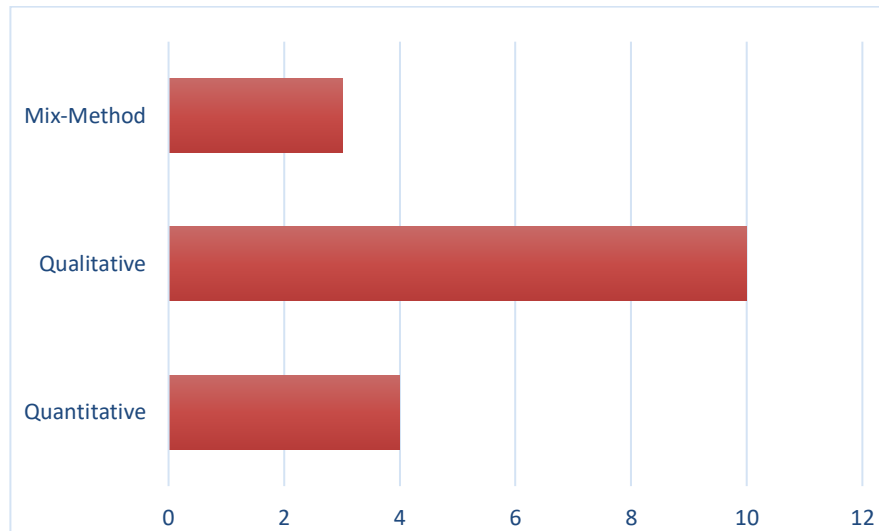


Figure 4. Studies Based on Research Methods

Based on Figure 4, the research method that is often used in examining students' mathematics learning difficulties in terms of metacognitive abilities is qualitative research methods, there are 10 studies that use qualitative methods. This is because students' learning difficulties must be identified in depth and presented in descriptive form and analyzed inductively, so as to produce knowledge about students' mathematics learning difficulties in more detail (Sudiman, 2022). While 4 studies used quantitative methods and 3 studies used mix methods.

Study Based on Co-Occurrence of Author Keywords

The following presents co-occurrence based on the author's keywords which can be seen in the figure below.

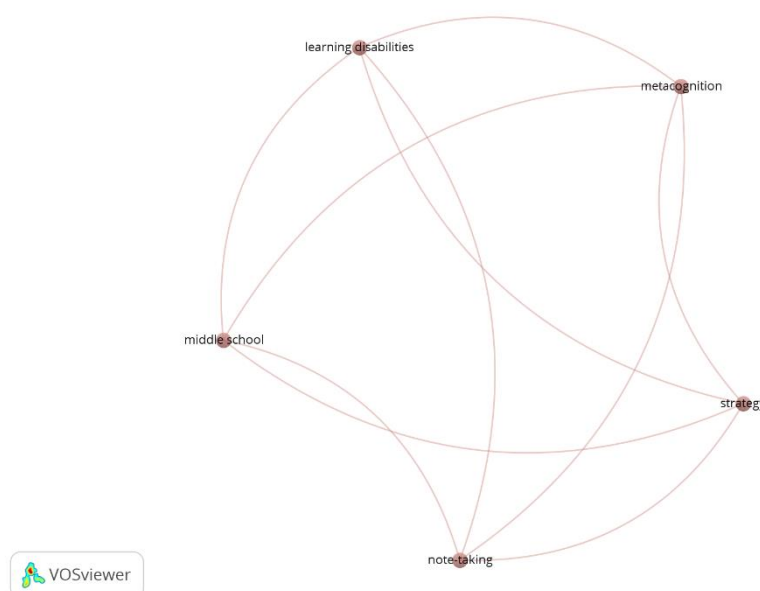


Figure 5. Co-Occurrence of Author Keyword

Figure 5 shows that there are five keywords used by the authors in the 17 articles analyzed, namely learning disabilities, metacognition, middle school, note-taking, and strategy. These five keywords have the same percentage of occurrence of 20%. This means that the research analyzed focuses on student learning difficulties and metacognitive strategies and is mostly conducted at the secondary level.

Analysis of Students' Learning Difficulties in Mathematics

Based on the analysis of 17 articles related to students' mathematics learning difficulties in terms of metacognition abilities, several mathematics learning difficulties experienced by students were found with the classification of students according to the category of their metacognition abilities and students' strategies in using metacognition abilities to minimize the learning difficulties experienced. The results of the analysis are presented in the table below.

Table 2. Article Analysis Based on Research Results

No	Researcher	Year	Result
1	T Rukhmana	2021	The mathematics learning difficulties experienced are related to understanding mathematical concepts. Students with moderate and low metacognitive abilities have difficulty

No	Researcher	Year	Result
			in restating a concept and classifying objects that fulfill the concept.
2	R. W Ilmi, N Sridana, U Lu'lulmaknun, Amrullah	2022	There were 6 students with high metacognition ability, 20 in the medium category, and 7 in the low category. Students have difficulty in applying objects based on prerequisites that form concepts, so they are still hesitant in answering questions.
3	R.A. Cahdriyana	2021	Of the 3 students observed, 2 students experienced metacognitive difficulties in learning mathematics using declarative and procedural knowledge.
4	D. Afriani, Rosyadi, M. Taufan	2021	Students with high metacognition have difficulty in reviewing the results of the answers they have done, students with low metacognition have difficulty in understanding the problem, thinking about the plan, implementing the plan, and reviewing the answer to the problem.
5	I. P. Saputri, A. Iriana	2020	The difficulties experienced by students are classifying objects based on the requirements that make up the concept, identifying the properties of operations or concepts, giving examples or non-examples, and presenting concepts in various forms of mathematical representation operations.
6	A. H. Hidayati, A. Setiani, P.S. Balkist	2021	Students have difficulty in understanding mathematical concepts based on the three categories of metacognitive abilities. These difficulties are caused by many factors such as students' lack of motivation and initiative in learning mathematics.
7	A.Sudiman	2022	Students with high metacognition skills with a score of 91-120 were 4 students, a medium category with a score of 61-90 were 20 students, and a low category with a score of 30-60 were 6 students. The difficulties

No	Researcher	Year	Result
			experienced by students are mostly in implementing answer plans on mathematical problems.
8	J. R. Boyle, S. M. Rosen, G. Forchelli	2016	Students have difficulty in using cognitive strategies to process information that has been learned.
9	H. Bessoondyal	2017	Most of the math learning difficulties experienced by elementary school students are a lack of conceptual understanding, students can perform calculations, but cannot explain the calculation process. In addition, students cannot analyze what is known in the problem properly so that they provide the wrong solution.
10	C. Rosenzweig, J. Krawec, M. Montague	2021	The learning difficulties experienced by students are related to verbalization and metacognitive behavior patterns. Students find it difficult to use the right resources in solving math problems. Only 42% of students can overcome learning difficulties by using verbalization and appropriate metacognitive strategies.
11	Deshpande, D.S., Riccomini, P.J., Hughes, E.M., Raulston, T.J	2021	The results showed that the learning difficulties experienced by students were verbalizing mathematical symbols, which hindered students' problem solving.
12	Mastrothanais, K., et al	2018	Students from both grade 5 and 6 groups showed some similarities in using metacognitive knowledge. The learning difficulty experienced is the regulation of cognition as a superior level cognitive process. Female students more often use cognition regulation strategies rather than cognition knowledge.

Table 2 above shows that most of the students' learning difficulties in mathematics are related to problem solving skills and concept understanding. Students have difficulty in classifying objects based on the requirements that make up the concept, identifying the properties of operations or mathematical concepts and symbols. In addition, students also have difficulty in using metacognition

strategies and arrangements and applying their declarative and procedural knowledge. Therefore, educators are expected to innovate in developing and implementing learning that can facilitate the process of forming students' metacognition skills, especially in developing problem solving skills. In addition, further research is needed in the form of meta-analysis as conducted by Juandi & Tamur (2021) regarding one of the recommendations for learning models, namely problem based learning (PBL) to improve students' mathematical thinking skills.

D. Conclusion

Based on the systematic literature review analysis that has been carried out, it is found that research on mathematics learning difficulties in terms of metacognition skills has not received considerable attention. This is indicated by the small number of studies conducted each year, especially in countries other than Indonesia. A total of 4 studies were conducted in the United States at the junior high school level, and only 1 article each from other countries such as Italy, Turkey, and Greece at the elementary school level. The European continent focuses more on improving metacognition skills at the elementary level because students must have awareness of their metacognition skills earlier, so that in learning at the next level, students can minimize the learning difficulties caused. Because of the importance of metacognition skills for students' future, it is recommended for future researchers to implement mathematics learning that can develop metacognition skills starting from the elementary school level and integrate with appropriate learning models in order to overcome students' mathematics learning difficulties.

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