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SYSTEMATIC LITERATURE REVIEW: STUDENTS' REFLECTIVE THINKING SKILLS IN MATHEMATICS LEARNING

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ABSTRACT

Students' reflective thinking skills are very important in achieving educational goals. Reflective thinking skills have a big role in the process of solving the problems. The involvement of reflective thinking processes in mathematics learning will influence the achievement of learning outcomes. This research aims to describe the results of research on students' reflective thinking skills in mathematics learning. The method used in this research, namely systematic literature review (SLR) which is guided by the Preferred Reporting Items for Systematic Review and MetaAnalysis (PRISMA). This research has collected information and study results from researchers from all over the world to provide a general overview of research on students' reflective thinking in mathematics learning. The key question in this research is how these articles are distributed based on year of publication, level of education, method, conceptual framework of reflective thinking, levels and indicators of reflective thinking. The results of the research show that studies related to reflective thinking skills in 2017 to 2023 are a period of growth in the publication of articles in reputable international journals, especially in scopus. Research on reflective thinking is mostly carried out at the secondary school level, most studies on reflective thinking apply qualitative methods, it is obtained several levels and indicators in students' reflective thinking and some do not report them. The implications of this research will be reference material that describes students' reflective thinking to improve mathematics learning outcomes.

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1. INTRODUCTION

Various skills in the 21st century are really needed in mathematics learning for students. One of them is reflective thinking skills which have a big contribution to the process of solving the problems (Nisak, 2004). Education is a social process in which immature members of society (especially children) are invited to participate in society. When someone wants to solve a problem, someone must understand the appropriate method to apply. This is to find a solution so that the problem can be resolved. Considerations regarding the method to be applied come from a person's reflective thinking.

Reflective thinking skills are a person's ability to select the knowledge they already have.This knowledge is neatly stored in memory and can be used to solve a problem in order to

achieve certain goals. Someone who has reflective abilities will find it easier to remember structured information, read by understanding and interpreting texts, solve problems, and make decisions through a mature thinking process (Nass & Moon, 2000). By using knowledge reflective thinking is viewed as an incredibly active and demanding activity (Kholid et al., 2020). One way to measure knowledge is a person's capacity for conceptual relationship-making (Hill et al., 2008). Reflective thinking is described as any confusion related to problem solving, therefore in order to solve a, problem with it, a person must be able to analyze, assess, and motivate themselves (Gurol, 2011). Reflective thinking helps someone consider a course of action and assess whether it is acceptable for solving a problem (Gencel & Saracaloğlu, 2018).

It is further said that the reflective thinking in learning process means a mental process that will manipulate the mind to find solutions. Reflective learning makes it easier to process new thoughts and information to be interpreted and studied in depth and with full consideration and caution before deciding on the next step (Xie et al., 2008). Research on students' reflective thinking skills in mathematics learning has developed. This research is useful for evaluation and efforts to improve learning outcomes.

The reflective view specifically by (Boud, 1989) explains the importance of reflection in the 'cooperative inquiry' process, which sees the importance of reflection for the development of learning. Reflection as an important part of the learning process 'experiental learning' or experience-based learning (Kolb, 1984; Makrygiannis et al., 2014). Reflective thinking in learning enables effective personal development, developing the future and applying action with the formula that learning is influenced by interaction with other groups through dialogue, conversation, communication to provide new understanding and experiences (Thurm et al., 2023).

Reflective thinking in learning allows students to focus more on paying attention, thinking, having their own ideas, paying attention, looking for solutions, interpreting, assessing and making self-reflections on what is around them (Duff & Duffy, 2002). By the reflective thinking skills they have the ability to link conditions in existing problems with the knowledge they have and then put forward conclusions as solutions and evaluate themselves in the learning process. From the literature search process that has been carried out regarding reflective thinking in mathematics, it is concluded that reflective thinking in mathematics really needs to be applied and highlighted. This is because the ability to think reflectively is one of the pillars in the educational process, as stated that reflection is one of the important pillars in learning with a constructivist character, because reflection can help students develop metacognitive awareness.

Research conducted by (Thapa et al., 2021) shows that reflective thinking is a useful tool in mathematics. According to (Agustan & Siswono, 2017), it can be inferred that reflective thinking contributes to reducing a person's vulnerability when they struggle to identify a solution and reach a conclusion.

Research by (Agustan et al., 2017) shows that reflective thinking provides students with the opportunity to improve their weaknesses in solving mathematical problems. This can foster accuracy and concentration in solving a mathematical problem. In this way, students will get correct and logical answers by thinking reflectively. Meanwhile, research conducted by (Simacon & Veloria, 2022) shows that respondents have high levels of reflective thinking skills and mathematical resilience and have a moderate attitude towards problem solving. The reference for

this research as the basis for SLR is: research by (Ramadhani & Juandi, 2020) and (Sholikhin et al., 2021).

From several studies that have been presented, at least researchers can see the urgency of reflective thinking in mathematics for students as an effort to improve students' weaknesses in solving mathematical problems, to foster students' accuracy and concentration, and to increase other variables that support successful mathematics learning such as mathematical resilience and problem solving. Researchers assess that students' reflective thinking in mathematics has become a fairly urgent research topic in terms of research at various levels, scopes, lesson topics in mathematics, and its relationship with other thinking skills in mathematics learning. For example, there is research on the concept of students' reflective thinking in statistical calculations, there is research on the relationship between students' reflective thinking skills and the level of routine and non-routine problem solving.

Based on the literature review that the researchers conducted, several systematic literature review articles were found in this topic did not mention the indicators or the levels, thus becoming a deficiency in this study. Therefore, this research was conducted as a means for researchers who are interested in studying students' reflective thinking skills at all levels of education, especially for other researchers in looking for research gaps.

The aim of this research is to describe the results of research on students' reflective thinking skills in mathematics learning which published in the last 6 years, namely 2017-2023, obtained from the Scopus and Google Scholar databases. To achieve this goal, the researcher formulated several relevant research questions as follows: '

1) How is the distribution of articles in terms of year of publication?
2) How is research applied on reflective thinking skills at all levels of education, scope and teaching topics in mathe matics (sample/subject) studied?
3) What is the distribution of articles based on the research methods used?
4) How is the conceptual framework formed to describe reflective thinking?
5) What are the indicators or levels of reflective thinking skills in mathematics?

2. METHOD

The preparation of this Systematic Literature Review (SLR) follows the Preferred Reporting Items for Systematic Review and Meta Analysis (PRISMA) guidelines. In applying the PRISMA guidelines, researchers discuss the methods used to select articles related to "students' reflective thinking". The PRISMA method includes sources from scopus and google scholar which were used to conduct a systematic review. The PRISMA guidelines used include eligibility criteria, information sources, search strategies, selection processes, data collection processes, and data items. At this eligibility criteria stage, we conducted a literature review of all articles published in scopus and google scholar indexed journals that studied "students' reflective thinking". One of our considerations in selecting articles is the year of publication. We only reviewed articles published in the last 6 years, namely from 2017 to 2023. We excluded articles from this literature review study if the article did not use the variabel "students' reflective thinking". We excluded articles that were not in the context of mathematics education and did not use english language. Below we present a table of criteria for determining articles reviewed:

Table 1. Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Publication 2017-2023	Publication before 2017
Indexed Journal	Non-indexed journals, journal reviews, book reviews, books, dissertations, theses, blogs, and others
Mathematics Field	Other general topics that are not mathematics, such as sociology, health etc
Use English Language	Doesn't use English
The article contains student's reflective thinking	The article does not include reflective thinking

Articles in this study were carried out by writing the keyword "Reflective Thinking" or "Students' Reflective Thinking" in the search column. Next, we filtered the database based on predetermined inclusion and exclusion criteria. Based on the systematic article search stage, 18 studies were obtained that met the established criteria. In the data collection process, we choose the method used to collect data from the selected articles. Apart from that, we presented article systematically and determined all other variables whose data were sought. The data taken from each study includes the author, research period, research design, number of samples/subjects, how the research was carried out, where the research was carried out and the research results obtained. Article search results are presented in the following scheme:

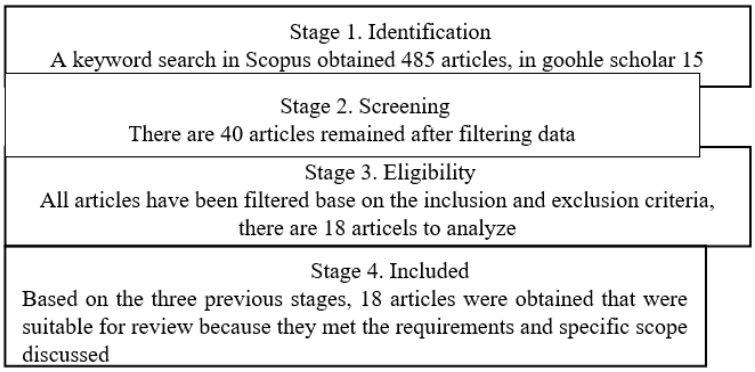

Figure 1. Diagram of Systematic Literature Review

3. RESULTS AND DISCUSSION

The findings in this research were prepared based on the need to answer the problem formulation. As for the results of the literature study carried out, data will be presented on a number of articles reviewed by publication year, level of education, method, conceptual framework for students' reflective thinking, indicators and levels of reflective thinking. Based on the application of the PRISMA method in selecting relevant articles, 18 articles were selected which will be presented in the form of tables, diagrams or pictures to make the interpretation process easier. Next, a critical analysis is also presented to answer the problem formulation in detail and precisely.

Review by year of publication

The diversity of 18 research articles on students' reflective thinking skills in terms of the characteristics of publication year is presented in Table 2 below:

Table 2. Number of Studies Based on Publication Year Criteria

Year of Publication	Frequency
2017	1
2018	0
2019	3
2020	4
2021	7
2022	2
2023	1

From table 2 above, it can be seen that the number of studies related to students' reflective thinking in mathematics learning published from 2017 to 2023 has experienced an increase and decrease in the number of publications. We can also see from the data presented above that 2021 are the peak development of the publication articles related to students' reflective thinking in international mathematics learning. This review shows an increasing of students' reflective thinking skills articles in mathematics learning with 5 articles per year published in the period 1980–2016 in the scopus database and google scholar. Based on the results of the interpretation of table 2, students' reflective thinking skill research in terms of year of publication has not a trend that continues to develop in recent years. Therefore, research related to students' reflective thinking skills in mathematics learning still has the potential to develop rapidly in certain periods considering the importance of describing reflective skills.

Studies based on education level and sample

The articles sampled in this research are grouped based on the level of education taken by the sample in the articles that have passed systematic study selection. Consid ering that the selected articles come from various countries with different education systems, the researcher presents data on students' educational levels by considering the samples studied. The following is a presentation of article data based on education level:

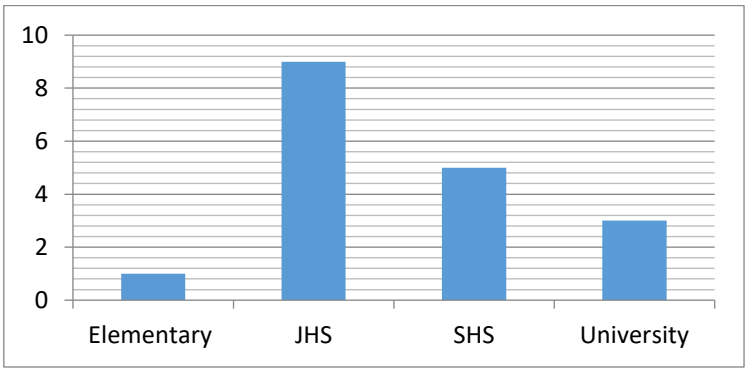

Figure. 2. Research Data on Reflective Thinking Based on Educational Level

From Figure 2, it can be seen that students' reflective thinking skills have been most researched in junior high schools (JHS) with 9 studies, while for the Senior High School (SHS)

level there were 5 studies, and 1 at the Elementary School and College levels. The pic ture above shows that researchers are more interested in conducting research on reflec tive thinking skills at junior high school (JHS) level. And there are still few found at elementary school and university levels. Researchers found that research related to reflective thinking skills is widely applied to junior high school (JHS) education because at this level the ability to think reflectively is in the spotlight, in other words, reflective thinking problems often appear or begin to appear at this level, one of which is because of the ability problem solving and critical thinking often begin at this level. Meanwhile, in elementary school there is more of an introduction process. At the high school (SHS) and tertiary levels, reflective thinking skills have at least been formed from habituation at the previous level. At the elementary school level, students still receive direct guidance or direction from the teacher for the development of reflective thinking. Meanwhile, at junior high school level, students' ability to think independently is starting to be demanded.

Study based on applied research methods

The next study is related to the research methods applied in research on students' reflective thinking in mathematics learning. The increasing amount of research related to reflective thinking has an impact on the development of research methods and data analysis to answer problem formulations carefully and precisely. Below is presented data on students' reflective thinking in mathematics learning based on the research method used in table 3.

Table 3. Study Views Based on Research Methods

Method	Instrument	Frequency
Qualitative	Written tests, interviews, documentation, questionnaires, observations	13
Quantitative	Written tests, quesionnaires	5

Based on table 3 above, we can see that 72.2% of the articles reviewed in this study used qualitative methods and 27.8% used quantitative methods. Quantitative methods were applied to some studies that correlated with other variables, such as problem solving, critical thinking, and academic achievement which were then solved using structural equation models or using regression or correlation analysis. The most widely used data reported in the articles was test data, while many articles supplemented their test data with other data sources collected mainly interviews, observations, and documentation.

Study based on the conceptual framework of reflective thinking skills

The results of researchers' findings in the conceptual framework study of reflective thinking are very diverse. Several researchers in this SLR article present components or indicators of reflective thinking in different ways and language. Below we present a classification of the conceptual frameworks built by each re searcher:

Table 4. Classification of Conceptual Frameworks of Reflective Thinking

Conceptual Framework	Frequency
The indicators of mathematical reflective thinking skills tested include: identifying problems, interpreting problems, evaluating problems, predicting problem-solving, and drawing conclusions.	1
Mathematical reflective thinking skills consist of three phases: reacting, elaborating, and contemplating	6
Consistency, Specificity, Intersubjectivity, Contextual Relevance, Contextual Relevance, Formatting Power, Insight	1
Questioning, evaluating, and reasoning	1
Reflective thinking where the indicators are not explicitly mentioned but the indicators are seen implicitly in the definition.	7
Identify facts and questions, explain the operation to be chosen, carry out the plan, and provide a logical conclusion with indicators that students write the correct final answer	1

In relation to the main criticism raised in the previous discussion, regarding the different indicators of reflective thinking among researchers, we found that the majority of articles did not define the concept of reflective thinking in its entirety, or only partially defined it. In addition, some articles allocated some of their arguments from the theoretical background to revisit the previously stated definition. In this regard, there seems to be a need for awareness in the field of the importance of elaborating indicators of reflective thinking in their research.

Studies based on levels of reflective thinking skills

Research on students' reflective thinking in mathematics learning has opened up a wider realm of thought. Because students' reflective thinking is very important in the process of learning mathematics. Almost all aspects require students' reflective thinking skills, both in problem solving and other abilities. Some studies show the levels of students' reflective thinking. The following is a table of students' reflective thinking levels.

Table 5. Level of Reflective Thinking of Students in Learning Mathematics

Levels	Frequency
High, Moderate, Low	8
Able in All Indicators, Not Able in some indicators	1
Deep understanding, connecting concepts, making mistakes and willingness to correct them, and confidence in answers.	1
Not mentioned	8

Based on Table 5, it is known that there are several definitions of different levels of reflective thinking in several studies. This grouping is based on the achievement of indicators of students' reflective thinking in mathematics learning.

This discussion is organized based on previous findings. From all articles reviewed from 2017 to 2023, there is an increase in publications related to the topic of students' reflective thinking skills in mathematics learning. The research trend related to this topic in recent years has developed insignificantly. This shows that the ability to think reflectively is less highlighted. In line with the

results of a preliminary study conducted at one of the junior high schools in Karawang, it shows that mathematical reflective thinking skills are still low. This is because the learning process is still dominated by the teacher. Teachers still play an active role in finding concepts in solving problems without involving students (Hudaini & Lestari, 2023). Whereas the ability to think reflectively has a huge impact in solving math problems (Amalia & Widodo, 2018). Therefore, research can be conducted related to students' reflective thinking ability in mathematics learning in the future considering the importance of reflective ability.

Research on the topic of students' reflective thinking ability based on education level is junior high school in the first place, high school in the second place, elementary school in the third place, and university in the last place. The researcher found that research related to reflective thinking ability was explored a lot in junior high school education because at this level reflective thinking ability is in the spotlight, in other words, the problem of reflective thinking is emphasized to prepare for higher education. Meanwhile, in elementary school there is more of an introduction process. At the senior high school and university levels, the ability to think reflectively has at least been formed from habituation at the previous level. At the elementary school level, students still get direct guidance or direction from the teacher for the development of reflective thinking. Meanwhile, at the junior high school level, students' ability to think independently begins to be demanded.

This research mostly applies qualitative methods to reveal students' reflective thinking ability in learning mathematics using written test instruments, interviews, documentation, filling out questionnaires, and observation. Meanwhile, quantitative methods were applied to see correlation or regression with other variables. The article focuses almost exclusively on test data supplemented by scaled questionnaires to measure variables.

Regarding the conceptual framework of reflective thinking, the majority of articles do not define the concept of reflective thinking as a whole. In this case, there needs to be awareness in the field of the importance of elaborating indicators of reflective thinking. The weakness often lies in the operationalization of reflective thinking, namely in stating what the indicators of thinking are. Some articles have presented indicators of reflective thinking, but they are quite diverse, making it difficult to determine the exact operationalization of all indicators of reflective thinking ability. Therefore, the researcher believes that the indicators of students' reflective thinking ability lie in how students' reflective thinking relates to other variables such as problem solving and critical thinking variables in mathematics. This of course includes several aspects. Indicators of reflective thinking must be strengthened in order to produce good and correct data.

There are several levels of students' reflective thinking that have theoretically been classified by each researcher. Based on the literature study that has been conducted, some researchers divide the levels into three, some only divide into two and some are more than three. This grouping is based on what indicators are contained in students' reflective thinking skills. This of course goes back to the previous discussion on how the conceptual framework of reflective thinking is built through a definition or operational framework.

4. CONCLUSION

This research concluded that studies related to students' reflective thinking skills in mathematics learning published from 2017 to 2023 were unstable, experiencing an in- crease or decrease in the number of publications, 2021 were the peak development of articles publications related to students' reflective thinking skills in journals. Reputable international researchers are more interested in conducting research on students' reflective thinking skills in junior high school which is characterized by a dominant number of articles. Most studies on students' reflective

thinking skills apply qualitative methods using test instruments and interviews as key instruments in describing students' reflective thinking skills. The conceptual framework of students' reflective thinking skills lies in how students can apply reflective thinking indicators in dealing with problems. Researchers divide the levels of reflective thinking into three and some only divide them into two and there are more than three. This grouping is based on any indicators of students' reflective thinking. This of course goes back to the previous discussion regarding how the conceptual framework for reflective thinking is built through definitions or operational frameworks. We hope that the systematic literature review article related to students' reflective thinking skills in learning mathematics can be reference in conducting similar research that considers theoretical and methodological aspects. Suggestions for future researchers to be clearer in presenting indicators and levels in this students' reflective thinking skills study, especially in developing students' reflective thinking instruments, and when linked to other variables.

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