

# Instructional Strategies for Fostering Mathematical Literacy in Junior High School: A Systematic Literature Review

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## Abstrak

Proses pembelajaran yang baik tentu mempertimbangkan bagaimana memulai pembelajaran dengan baik. Banyak studi yang mengatakan penggunaan konteks dalam pembelajaran mampu menggiring siswa dalam pemahaman masalah yang baik. Begitu juga dengan literasi matematika, dimana dalam mengungkap kemampuan literasi matematika harus bermula dari problem in context. Penyusunan SLR dalam penelitian ini mengikuti pedoman PRISMA. Pemilihan metode PRISMA sebagai upaya untuk menyeleksi jurnal-jurnal terindeks scopus dan Mathematical literacy menjadi kata kunci. Terbitan artikel yang disaring yaitu tahun 2019-2023, dimana artikel yang ditemukan dari database berjumlah 210 artikel, artikel setelah duplikasi dihapus berjumlah 170 artikel, artikel yang melewati penyaringan awal sebanyak 130 artikel, kemudian artikel yang dinilai kelayakannya sebanyak 40 artikel, dan pada akhirnya ada 25 artikel final yang dianalisis. Kemampuan literasi matematika yang ingin diungkap adalah kemampuan literasi matematika pada level junior high school. Pada level SMP merupakan level yang paling tepat untuk melakukan penelitian yang berkaitan dengan kompetensi literasi matematika. Kemudian penggunaan konteks dunia nyata sebagai awal untuk pengenalan matematika dalam memulai proses pembelajaran, sehingga literasi matematika yang dimau adalah yang dimulai dari penggunaan konteks hingga pada akhirnya siswa mampu mengaplikasikan ilmunya untuk menyelesaikan masalah matematika dan juga mewujudkan kemampuan seseorang untuk memformulasikan, menggunakan, dan menafsirkannya dalam permasalahan matematika pada berbagai konteks kehidupan.

**Kata Kunci:** Systematic Literature Review; Matematika Literasi; Strategi Pembelajaran.

## Abstract

A good learning process certainly considers how to start learning well. Many studies say that using context in learning can guide students to a good understanding of the problem. The same goes for mathematical literacy, where revealing mathematical literacy skills must start from problems in context. The SLR in this study follows the PRISMA guidelines. The PRISMA method was chosen to select Scopus-indexed journals, and mathematical literacy was used as the keyword. The articles published were from 2019 to 2023. A total of 210 articles were found in the database. After removing duplicates, there were 170 articles. A total of 130 articles passed the initial screening, and 40 articles were assessed for suitability. Finally, 25 articles were analyzed. The mathematical literacy skills to be revealed were mathematical literacy skills at the junior high school level. Junior high school is the most appropriate level for conducting research related to mathematical literacy competence. Then, the use of real-world contexts as a starting point for introducing mathematics in the learning process, so that the desired mathematical literacy begins with the use of contexts until students are ultimately able to apply their knowledge to solve mathematical problems and also realize their ability to formulate, use, and interpret mathematics in mathematical problems in various contexts of life.

**Keywords:** Systematic Literature Review; Mathematical Literacy; Instructional Strategies.

## I. INTRODUCTION

What is learning mathematics? (Ernest, et.al. 2016) This question prompts us to consider how to truly learn mathematics. Of course, truly learning mathematics means enabling students to construct knowledge independently (Gravemeijer et al., 2006); (Gravemeijer et al., 2017). Mathematics must begin with meaningful problem situations for students that offer them the opportunity to attach meaning to the mathematical constructions they develop while solving problems (Lerman, 2014).

Mathematics subjects are organized into five content elements, the first of which is Numbers (BSKAP Kemendikbudritek, 2022). Within the Numbers element, one of the difficulties is understanding negative numbers (Vlassis & Demonty, 2022; Fuadiah, Suryadi, & Turmudi, 2017) as well as ordering numbers (Askew & Venkat, 2020). Given these conditions, when we want to guide students to learn mathematical concepts in this topic, we must do so in an intuitive way, framed by a real-life context so that students learn concepts through various representations and make connections between these representations (Kaur, Wong, and Govindani, 2020).

Difficulties in solving mathematical problems are partly caused by difficulties in understanding (Phonapichat, Wongwanich, & Sujiva, 2014). The above problems illustrate the need for a literature review to identify the strengths of the research, see the extent to which the research has been conducted, and identify opportunities for further research. The systematic literature review (SLR) is considered important

because a perspective that is rarely touched upon at the SLR level is context-based mathematical literacy. Therefore, this SLR is important. The method used is SLR with the stages outlined in the Figure 1.

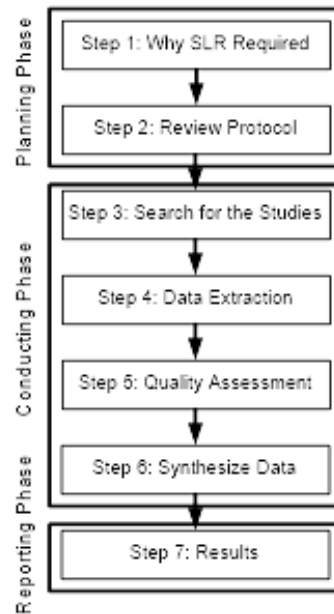


Figure 1. Steps followed for a systematic literature review (SLR) (Sabir et.al, 2018).

## II. METHOD

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) is used as a guideline for compiling SLRs (Moher et al., 2015). The PRISMA method was chosen with the aim of producing systematic reviews (Page et.al, 2021) by utilizing Publish or perish (Chavez, et.al, 2021) to select Scopus-indexed journals and focus on the keyword Mathematical literacy and context. Correct use of PRISMA will provide solutions for updating research that has been done (Stovold, et.al, 2014). The phases used in this study are the identification, screening, eligibility, inclusion, and data extraction phases from the included studies (Nogues & Dorneles, 2021). Scopus-indexed journals

were selected based on the consideration that the articles had undergone a rigorous peer-review process and provided consistent metadata. Thus, the results of this SLR serve as a reliable reference for further research. The articles reviewed were published between 2019 and 2023.

### III. RESULT AND DISCUSSION

initial stage carried out was to utilize the Publish or Perish application to search for data related to Mathematical literacy data. The data that was recorded qualitatively can be seen in the Figure 2.

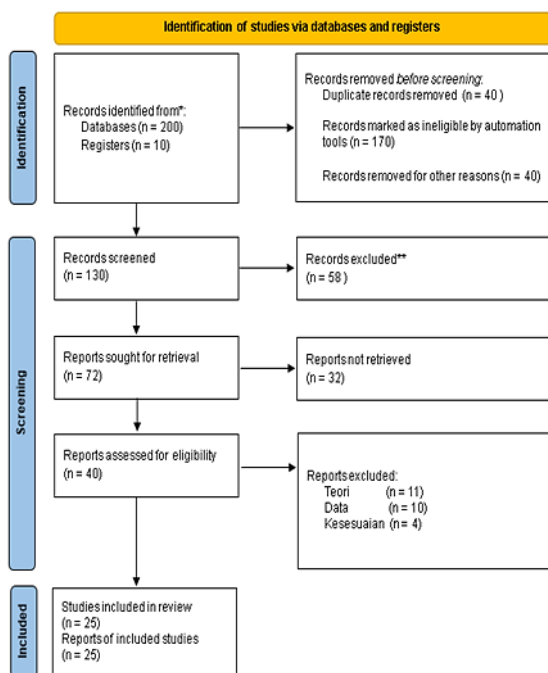


Figure 2. Flowchart for publication search (<http://prisma-statement.org/>).

The results of the journal article research are in the form of a literature review by analyzing and summarizing various sources related to Mathematical Literacy. The results of the study are presented in Table 1.

Table 1.  
Research Results

Name	Results
Umbara, 2019	Teachers must first understand

Name	Results
	mathematical literacy assessment, there is input to be able to campaign for mathematical literacy in various teacher communities which can be done simultaneously, structured and systematically so that teachers have targets in developing student literacy and have an impact on increasing Indonesia's ranking in the PISA survey.
Rizki, 2019	Mathematical literacy skills for students are measured by how well students are able to reason mathematically and perform modeling and problem solving in the context of everyday life.
Genc, 2019	several groups of teachers in the concept of mathematical literacy, namely mathematical skills, problem solving, reasoning, and argumentation
April, 2019	Traditional games can be used as an alternative to develop mathematical literacy, where through these traditional games an understanding of the problems given emerges, creating strategies, solving problems and communicating the results.
Amir, 2019	The "Benteng" game can be modified and integrated with the mathematics literacy learning process. In other words, the integration of mathematics literacy and games can be applied
Umbara, 2019	The use of the Realistic Mathematics Education (RME) learning approach combined with information technology is an alternative for training mathematical literacy skills.
Kurniawati, 2019	Students have difficulty when formulating situations mathematically and making arguments.
Retnawati, 2019	There needs to be an introduction to the literacy

Name	Results	Name	Results
	context for students so that they become accustomed to solving mathematical problems, and teacher competence in training student literacy in schools needs to be improved.		literacy skills.
Ozgen 2019	Mathematical literacy skills can be trained and developed by considering the diversity of mathematical contexts and content.	Holenstei, 2020	It was found that Mathematical Literacy consistently supports general academic achievement.
Gabriel, 2020	In his research, he showed that mathematical anxiety has a negative impact on perseverance and perseverance has a positive influence on self-efficacy and ultimately has a positive impact on mathematical literacy.	Shaumiwaty, 2020	The teacher's mathematics performance in learning is teaching and checking.
Pradana, 2020	That the virtual mathematical device approach has a big impact in supporting students' mathematical literacy skills. With virtual mathematical devices, the competencies gained are formulating mathematical problems, reasoning and creating ideas, applying, presenting and evaluating things related to mathematical problems.	Ekawati, 2020	The use of mathematical literacy tests is highly recommended in school learning in order to provide students with the opportunity to learn and solve mathematical literacy problems.
Main, 2020	The development of PISA-type questions has an impact on students' mathematical literacy skills and helps students apply mathematics in their daily lives..	Bolstad, 2020	The Norwegian curriculum considers mathematical literacy to be a skill that must be developed in all subjects, but teachers' difficulties in implementing teaching to develop this competency and in the learning process tend to occur only in procedural skills
Holy, 2020	The developed mathematical literacy test instrument can measure the achievement of mathematical literacy in three processes. Namely, formulating problems, using mathematical concepts, procedures, facts and reasoning in solving problems and interpreting, applying, and evaluating mathematical results.	Bahtiar 2020	Students' mathematical communication and logical thinking influence their mathematical literacy skills.
Collar, 2020	The integration of contextual problems in mathematics learning is the primary choice in developing mathematical	Fitrianawati 2020	There is significance between mathematical literacy skills and students' creative thinking.
		Thorndsen 2020	that children have gained experience in improving mathematical literacy when they attend preschool level.
		Hwang, 2021	Students' mathematical literacy can be improved through full engagement in mathematical learning tasks, such as word problems, routine tasks, and pure and applied reasoning.
		Adirakasiwi, 2021	The developed teaching materials are able to improve mathematical literacy
		Novita, 2021	The use of technology in learning is a necessity. So the instruments used must consider the pedagogical and mathematical aspects of students.
		Ahyan, 2021	Mathematical literacy is a topic that is in line with efforts to improve the learning process

Name	Results
	and the involvement of all elements, including teachers, students, parents, and the community

Table 2.  
Distribution of Mathematics Literacy Contexts

Context	Topic
Societal "10 artikel (40%)"	<ul style="list-style-type: none"> <li>o Mathematics literacy in the teacher community</li> <li>o Literacy development to improve PISA rankings</li> <li>o Integration of real-world problems in mathematics questions</li> <li>o Community involvement and curriculum</li> </ul>
Personal "7 artikel (28%)"	<ul style="list-style-type: none"> <li>o Traditional games to develop mathematical strategies</li> <li>o Use of virtual mathematical tools for individual learning</li> <li>o Improvement of students' problem solving and mathematical communication skills</li> </ul>
Scientific "5 artikel (20%)"	<ul style="list-style-type: none"> <li>o The influence of anxiety and self-efficacy on mathematical literacy</li> <li>o The application of mathematical literacy in experimental questions and scientific data</li> <li>o Procedural tasks and pure mathematical reasoning</li> </ul>
Occupational "3 artikel (12%)"	<ul style="list-style-type: none"> <li>o Mathematical literacy related to the world of work</li> <li>o Procedural understanding and practice in the context of work</li> <li>o Use of symbolic and procedural representations in the context of professions</li> </ul>

Table 3.  
PISA Content Domains and Topics Appearing in Articles

Domain	Topics
Change and Relationship "11 artikel (44%)"	<ul style="list-style-type: none"> <li>o Context-based mathematical modeling</li> <li>o Relationships between variables (algebra)</li> <li>o Mathematical reasoning and argumentation</li> </ul>

Domain	Topics
	o PISA model questions based on change
Quantity "7 artikel (28%)"	<ul style="list-style-type: none"> <li>o Number operations in everyday contexts</li> <li>o Measurement and comparison of quantities</li> <li>o Calculations based on traditional games</li> <li>o Contextual numerical decisions</li> </ul>
Uncertainty and Data "5 artikel (20%)"	<ul style="list-style-type: none"> <li>o Interpretation of data and information</li> <li>o Uncertainty in decision making</li> <li>o Basic statistical literacy</li> <li>o Relationship between data and affective factors</li> </ul>
Space and Shape "2 artikel (8%)"	<ul style="list-style-type: none"> <li>o Visual-spatial understanding</li> <li>o Contextual geometric representation</li> <li>o Spatial experiences since preschool</li> </ul>

Table 4.  
Mathematical Literacy Difficulties and Dominant Forms of Difficulty

Literacy Process	Dominant Form of Difficulty
Formulating "12 artikel (48%)"	<ul style="list-style-type: none"> <li>o Identify relevant information from the context of the problem</li> <li>o Translate the contextual situation into a mathematical model</li> <li>o Determine variables and assumptions</li> <li>o Develop an initial mathematical argument</li> </ul>
Interpreting "8 artikel (32%)"	<ul style="list-style-type: none"> <li>o Interpreting calculation results in the context of the problem</li> <li>o Evaluating the reasonableness of the solution</li> <li>o Drawing contextual conclusions</li> <li>o Communicating results mathematically</li> </ul>
Employing "5 artikel (20%)"	<ul style="list-style-type: none"> <li>o Procedural errors in calculations</li> <li>o Inappropriate formula selection</li> <li>o Inaccurate use of symbolic</li> </ul>

Literacy Process	Dominant Form of Difficulty
	representations

Characteristics	Variation	Amount
	Vocational School	1
	Student	2
	Teacher	3

Based on the Table 2-4, there are a description of the research that has been conducted in the last five years related to mathematical literacy. There are several findings, including at the level of education, it has been carried out starting from kindergarten to teacher level, then research related to mathematical literacy is very close to research related to the development of PISA-based questions. Furthermore, in an effort to improve mathematical literacy skills, the use of context is one of the efforts to master mathematical reasoning and ultimately improve mathematical literacy skills (OECD 2021).

The use of traditional games can be used as a context that can be integrated with the process of learning mathematical literacy. In other words, the integration of mathematical literacy and traditional games can be modified and integrated in the learning process and can maximize students' mathematical literacy (Amir, 2019). So there is room for the use of traditional contexts or games in order to modify and integrate in the process of learning mathematics.

Table 5.  
Article Characteristics Overview

Characteristics	Variation	Amount
Publication Year	2019	9
	2020	12
	2021	4
Educational level	Kindergarten	3
	SD	7
	JUNIOR HIGH SCHOOL	8
	SENIOR HIGH SCHOOL	1

From the data above, research activities related to Mathematical literacy were dominated in 2020 with the level that is often the subject of research, namely at the junior high school level with an age of 15 years in order to reveal PISA research, both the development of PISA questions and research studies in mathematics learning. Ahyan, (2021) concluded that the theme of Mathematical Literacy is still a current topic to reveal student competencies. Furthermore, from the results of the table data above, starting from the Kindergarten level to the teacher level, research is often carried out and as a simple assumption when the PISA score for Indonesia is still not optimal, then throughout that Mathematical literacy becomes a topic that is relevant to the condition of students' mathematics. And also always a current topic where when students have good Mathematical literacy skills, they can describe students' creative thinking abilities and are naturally able to come up with new ideas or find solutions to mathematical problems (Liljedahl & Sriraman, 2006).

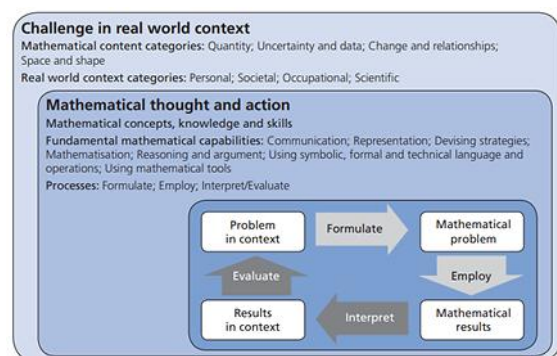


Figure 3. A model of mathematical literacy in practice (OECD, 2013).

The mathematical literacy model illustrated provides an illustration that mathematical literacy starts from a "problem in context" so that it can be interpreted that when you want to bring up mathematical literacy, you must start the problem with the context (see Figure 3). So that context becomes the main basis in a learning process. Mathematical literacy is the ability of individuals to be able to formulate, use, and interpret mathematics in various contexts (OECD, 2013). Furthermore, in mathematical literacy, there are three levels, namely knowing (knowledge and understanding), applying (application), and reasoning (reasoning) (Center for Educational Assessment, 2022). This situation describes the scope of mathematical literacy as follows:

Table 6.  
Format Baku Tabel

Category	Information
Domains in Mathematical Literacy	Number
	Geometry and Measurement
	Algebra
	Data and uncertainty
Cognitive Levels in Reading Literacy	Finding Information
	Interpreting and integrating
	Evaluate and reflect
Cognitive Levels in Mathematical Literacy	Understanding
	Implementation
	Reasoning

<https://tinyurl.com/pusmendikkemdikbud> (2022)

The overview of future research shows that mathematical literacy competency is still an up-to-date topic for research, then of course considering the use of context as a starting point for problem recognition so that it can be modified and integrated into the mathematics learning process so that the goal is to realize a person's ability to

formulate, use, and interpret mathematics in mathematical problems in various life contexts. OECD (2013). In the end, the thinking process in mathematical literacy skills includes being able to formulate, apply and interpret mathematical problems.

Mathematics learning will become a problem faced by teachers when they do not use contexts that can focus students and activate relevant concepts (Ahmed & Pollitt, 2001). Learning that presents real-life contexts will transform the situation into enjoyable learning for students (Duman & Oğuz, 2023). Furthermore, it bridges the gap between everyday reality and mathematics (Gravemeijer et al., 2007). Therefore, presenting real-life contexts is an alternative to promote student literacy (Bolstad, 2023). Mathematics is not limited to calculations, but also the ability to solve mathematical problems with logical and critical thinking skills (Kusumawardani et al., 2018). This is achieved in learning that links everyday contexts with mathematics learning (Gunay & Takunyaci, 2023).

#### IV. CONCLUSION

The junior high school level is the most appropriate level for conducting research related to mathematical literacy competencies. Then, the use of real-world contexts in this case is the use of game contexts as a starting point for introducing mathematics in the learning process. Then, bringing up mathematical literacy competency is an effort to create students who are able to formulate, use, and interpret mathematics in mathematical

problems in various contexts of life. So that when this is achieved, the learning process is complete. This study highlights the research gap in the domain of space and shape, which has been rarely studied. Furthermore, it is necessary to focus on context-based learning and mathematical modeling, as well as strategies to help students formulate problems correctly. One of these is to examine innovative learning strategies such as Realistic Mathematics Education to improve the ability to formulate problems and interpret solutions.

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