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STUDENTS LEARNING OBSTACLES RELATED TO MATHEMATICAL LITERACY PROBLEM: A SYSTEMATIC LITERATURE REVIEW

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ABSTRACT

This study aims to describe the results of research on learning obstacles related to mathematical literacy problems. This research uses the Systematic Literature Review (SLR) method. The sample consisted of 13 studies on learning obstacles related to mathematical literacy problems published from 2017 to March 2023. The results of this study were reviewed based on the publication media, year of publication, level of study, research location, materials used in the study, and results on learning obstacle research related to mathematical literacy problems. Using the SLR method, It was found that the most research was published in the Repository UPI while the most articles were published in SINTA 3, the highest number of published research in 2022, the highest level of education is carried out at the junior high school level, the location was predominantly carried out in Java Island, Space and Shape content and Uncertainty and Data content was most widely used in learning obstacle research related to mathematical literacy problems, and in terms of three types of learning obstacles namely, ontogenic obstacles, didactical obstacles, and epistemological obstacles. It was detected that epistemological obstacles were found in as much as 100% throughout the study, while ontogenic obstacles were found in as much as 69%, and didactical obstacles were found in much as 46%.

Keywords: Learning Obstacle, Mathematical Literacy, Systematic Literature Review

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PRELIMINARY

Mathematics is the knowledge that is needed by every human being. Mathematics is used in everyday life as well as in the advancement of science and technology, so it needs to be taught from an early age (Yusuf et al., 2017). Although mathematics is indispensable in supporting one's life, there may still be many people who dislike math. This is in line with Handayani & Mahrita (2021) opinion that several students said they were never happy with learning mathematics. One of the factors that can cause this is the existence of obstacles or difficulties in learning mathematics. Fadillah et al., (2019) said

that the average student dislikes math because they find it difficult, has too many formulas used, and is convoluted. Learning obstacles is the term for these learning difficulties or obstacles. Learning obstacles are conditions in the learning process that are characterized by certain obstacles in achieving learning outcomes (Sulistiawati et al., 2015). There are 3 types of learning obstacles, namely ontogenic obstacles (these obstacles related to the mental readiness of students to learn or occurs due to the limitations of students in self-development), epistemological obstacle (the knowledge that students have is incomplete or limited so that there are limitations to the knowledge that students have in certain contexts) and didactical obstacles (due to the education system or obstacles that arise from the methods and approaches used by a teacher) (Brousseau, 2006; Cesaria & Herman, 2019). If the teacher does not know and correct the obstacles or difficulties experienced by students during the learning process, the impact of these obstacles or difficulties will continue.

Learning obstacles are often found in mathematics learning when students work on non-routine problems. Asdarina & Ridha (2020) said that students experience obstacles to applying their knowledge to solve non-routine problems. In addition, Sari & Roesdiana (2020) said that students are accustomed to working on problems that are exemplified by the teacher, so when presented with slightly complex problems, students have difficulty working on them. Non-routine problems are commonly found in problems that require mathematical literacy skills. The PISA 21 mathematics framework study explains that mathematical literacy connects mathematical reasoning, problem-solving, mathematical content, context, and 21st-century skills. The mathematical content domain contains mathematical material used for evaluation aspects and is the focus of PISA, in which there are four things, namely (1) Quantity is closely related to the relationship between numbers and number patterns; (2) Space and Shape are closely related to the subject matter of geometry; (3) Change and relationship is closely related to algebraic material; and (4) Uncertainty and Data are closely related to statistics and probability. (OECD, 2018). Mathematics literacy is the knowledge to know and apply basic mathematics in our everyday lives (Ojose, 2011). Mathematical literacy is a person's ability to formulate, apply and interpret mathematics in various contexts. (OECD, 2018). In mathematical literacy, it is not only enough to have mathematical knowledge but also to be able to use and apply mathematical knowledge to solve various problems in an increasingly developing world.

Several studies related to obstacles or difficulties experienced when solving mathematical literacy problems have become interesting to study in recent years because of the need to develop mathematical literacy skills. By knowing the obstacles or difficulties experienced by students, teachers can design a learning design by considering students' obstacles or difficulties to develop mathematical literacy skills. In addition to creating an appropriate learning design, teachers must familiarize students with non-routine problems related to mathematical literacy.

Although research on learning obstacles related to mathematical literacy has been conducted in recent years in various schools, various contents, various subjects, and various different locations, it is likely to produce some differences. A literature review is needed to get comprehensive information about students' learning obstacles related to mathematical literacy problems. Therefore, this study systematically reviews the literature on students' learning obstacles related to mathematical literacy problems using the Systematic Literature Review (SLR) method.

A systematic literature review (SLR) aims to identify, evaluate, and interpret the findings of primary studies. (Barricelli et al., 2019). Systematic Literature Review (SLR) is widely used by researchers to map out areas of uncertainty, identify research that has already been done, and explore new studies that are needed as in the above study (Hadi et al., 2019). Systematic Literature Review (SLR) research is conducted to identify, evaluate, and interpret all relevant research results related to a particular research question, topic, or phenomenon of interest (Kitchenham, 2004; Ramdhani, 2021). Like any good study, a systematic review follows a protocol (a detailed plan) that first sets out its main objectives, concepts, and methods (Juandi, 2021). The purpose of this study is to describe the results of research related to learning obstacles related to students' mathematical literacy problems in Indonesia based on publication media, research year, education level, research location, material in the analyzed research, and research results. One of the important steps in a Systematic Literature Review (SLR) is to collect data, which is to obtain data in the form of research results on learning obstacles related to mathematical literacy problems. Through the data obtained, the researcher asked the following related questions: (1) What is the description of research findings related to learning obstacles related to mathematical literacy problems in terms of publication media?; (2) What is the description of research results with learning obstacles related to mathematical literacy problems in terms of publication year?; (3) What is the description of research results with learning obstacles related to mathematical literacy problems in terms of education level?; (4) What is the

description of the research results with learning obstacles related to mathematical literacy problems in terms of the research location?; (5) How is the relationship between the description of research results and learning obstacles related to mathematical literacy problems in terms of the material used in the study?. As well as summarizing the results of research related to learning obstacles related to mathematical literacy problems in a qualitative approach.

METHODS

Systematic Literature Review

This research uses the Systematic Literature Review (SLR) method. A systematic review is a research method to identify, evaluate, and interpret all relevant research results related to research questions, certain topics, or phenomena of concern (Kitchenham, 2004; Rum & Juandi, 2022). The survey was conducted on secondary data in the form of primary research results regarding the analysis of learning obstacles related to mathematical literacy problems.

The research stages include data collection, data analysis, and conclusion drawing (Juandi & Tamur, 2020). The data collected are primary studies made into national and international journal articles and primary studies made into undergraduate theses, theses, and dissertations, data collected from electronic databases published by SINTA journals, Garuda Portal, Repository and Open Journal System (OJS). Next, extraction of all proceedings, journal articles, undergraduate theses, theses, and dissertations found was carried out. Only relevant proceedings, journal articles, undergraduate theses, theses, and dissertations that met the inclusion criteria were included in the analysis stage.

Inclusion Criteria

Inclusion criteria are a number of criteria or requirements that must be met so that the sample or research subject is declared eligible to participate in the study (Swarjana, 2022). To obtain data in accordance with the research objectives, the following inclusion criteria were set:

1) Research in the form of proceedings articles, journal articles, undergraduate theses, theses, and dissertations.
2) Research on analyzing learning obstacles related to mathematical literacy problems.

3) The period of the research was published from 2017 to March 2023 because no research was found on analyzing learning obstacles related to mathematical literacy problems in previous years.
4) Research conducted in Indonesia.
5) Research published by SINTA, Garuda Portal, Repository, and Open Journal System (OJS).
6) Research at the elementary school to university level.

Population and Sample

The population in this study is all qualitative research on analyzing learning obstacles related to mathematical literacy problems with research locations in Indonesia that have been published by SINTA journals, Garuda Portal, Repository, and Open Journal System (OJS). Based on the inclusion criteria, a total of 13 research samples were obtained consisting of 8 articles and 5 undergraduate theses, theses, or dissertations that were relevant and suitable for systematic review.

RESULT AND DISCUSSION

Study Based on Publication Media

In this study, the data collected was limited to research published in SINTA journals, Garuda Portal, Repository and Open Journal System (OJS). Research outside of these category boundaries was not included in this research analysis. The research analyzed in the form of journals, proceedings, undergraduate theses, theses and dissertations that can be accessed. The amount of research on analyzing learning obstacles related to mathematical literacy problems can be seen in Figure 1 below:

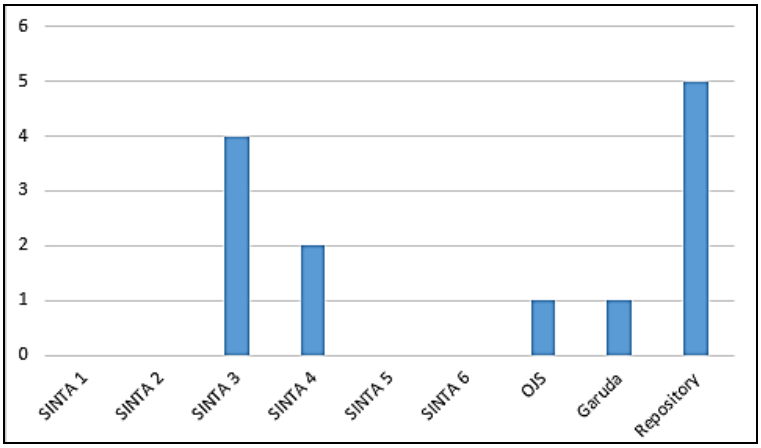

Figure 1. Study Based on Publication Media

From Figure 1 above, it can be seen that the results of research on learning obstacle analysis related to mathematical literacy problems are most published in the repository with a total of 5 studies. While in SINTA-indexed journals, the most published in SINTA 3, SINTA-indexed journals 1, 2, 5, and 6 were not found. SINTA 1 is the highest rank in the journal, the higher the rank of the journal, the better the quality and assessment of the quality of the substance of the scientific articles contained in the journal compared to the rank below (Yani et al., 2020). This can be a consideration for the author to be able to improve and deepen research on learning obstacles related to mathematical literacy problems so that it can be published in SINTA 1 or SINTA 2.

Studies by Year of Publication

By screening the collected research data using the inclusion criteria, 13 relevant studies were obtained for analysis. From the relevant data, the number of studies published each year is different which can be observed from Figure 2 below:

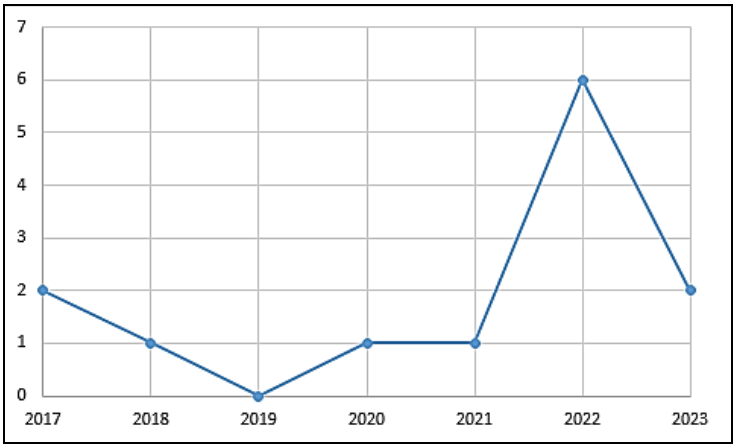

Figure 2. Studies by Year of Publication

Based on Figure 2, it can be seen that in 2019 no research on learning obstacles related to mathematical literacy problems was found. On the other hand, the highest number of publications in 2022 was 6 studies on learning obstacles related to literacy issues. The surge in research on learning obstacles related to mathematical literacy problems in that year could be due to the government's latest policy in 2021 related to AKM (Minimum Competency Assessment) which focuses on improving the quality of education in Indonesia, especially in mastering literacy and numeracy (Hasanah & Hakim, 2021). In line with the latest government policy, research on learning obstacles related to mathematical literacy issues needs to continue to be researched so that it can be taken into consideration in developing mathematical literacy skills.

Study by Education Level

Mathematical literacy is an important skill to be mastered by every student at every level of education. Mathematical literacy relates to the ability to apply mathematics in everyday problems (R. H. N. Sari, 2015). Research on learning obstacles related to mathematical literacy problems is conducted at every level of education to see students' obstacles in solving mathematical literacy problems. The following numbers at each level of education can be seen in Figure 3 below:

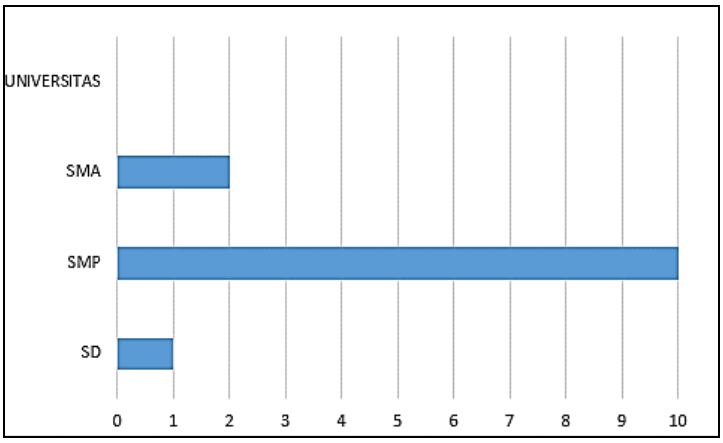

Figure 3. Study by Education Level

Based on Figure 3, research on learning obstacles related to mathematical literacy problems conducted in junior high schools is more dominant than research conducted at other education levels, namely 10 studies out of 13 total studies. On the other hand, no research was found at the University level. One factor that can cause no research to be found at this level is that the PISA (Program International Student Assessment) mathematical literacy assessment is made for students aged 15 years (Gal & Tout, 2014). However, learning obstacles related to mathematical literacy problems in elementary, high school, and university students should not be ignored or considered unimportant to study. Because if student learning obstacles are not detected and continue, it will have an adverse impact on the quality of student mathematics learning (Sumirat et al., 2023). So research on learning obstacles related to mathematical literacy problems is important at every level of education so that in the future learning designs can be made to overcome learning obstacles and improve mathematical literacy skills.

Study Based on Research Location

Indonesia is a country with many islands. There are five largest islands in Indonesia: Sumatra, Java, Kalimantan, Sulawesi, and Papua. The number of studies on learning obstacles related to mathematical literacy problems conducted in the five largest islands in Indonesia can be seen in Figure 4 below:

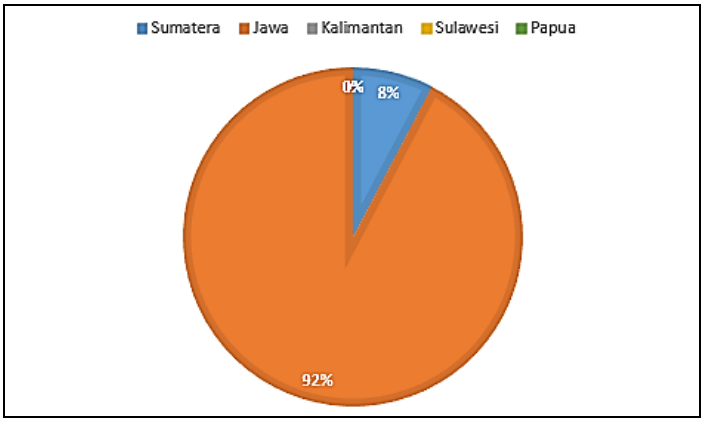

Figure 4. Study Based on Research Location

Based on Figure 4, it is known that research on learning obstacles related to mathematical literacy problems is mostly conducted on the island of Java as much as 92% or 12 studies. On the other hand, research on learning obstacles related to mathematical literacy problems on the island of Sumatra only found 8% or 1 study. On the islands of Kalimantan, Sulawesi, and Papua, no research was found on learning obstacles related to mathematical literacy problems. Research on learning obstacles related to mathematical literacy problems should be conducted in various provinces in Indonesia so that the obstacles related to the mathematical literacy of each student can be identified and solutions can be found to overcome these obstacles.

Studies Based on Research Materials

Mathematics is divided into several branches of science within it. In PISA mathematical literacy, there are 4 mathematical contents used, namely Space and Shape (closely related to the subject matter of geometry, covering phenomena related to the physical and visual world such as mathematical reasoning related to geometric shapes and spaces, including patterns, properties, position and orientation, object representation, navigation, and object coding), Change and relationships (relating to aspects of functions and algebra, including algebraic expressions, equations and inequalities, graphical and tabular representations, and interpretation of phenomena), Quantity (relating to number relationships and number patterns, including the ability to reason quantitatively, understand mathematical steps, perform estimations, and represent numbers), and Uncertainty and Data (Closely related to statistics and probability, including knowledge of uncertainty and measurement error, chance, and data interpretation) (OECD, 2018). The following details of the distribution of studies based on research material on learning obstacles related to mathematical literacy problems with a qualitative approach are presented in Figure 5:

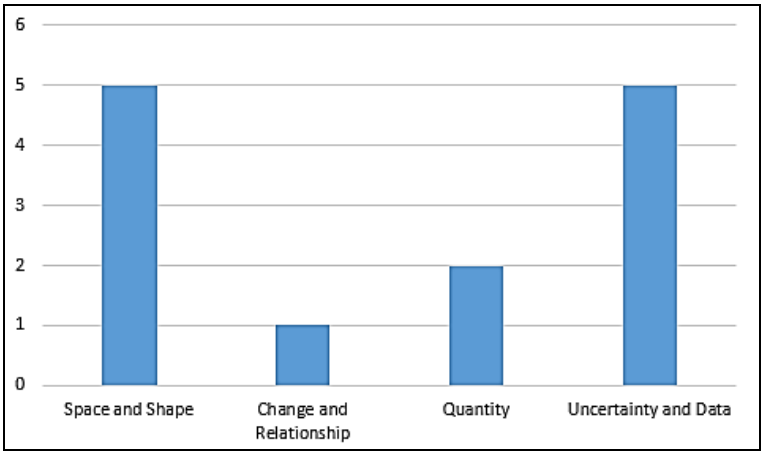

Figure 5. Studies Based on Research Materials

From Figure 5, it can be concluded that the results of the study of learning obstacles related to students' mathematical literacy problems with a qualitative approach mostly examined the content of space and shape or topics related to the subject matter of geometry and uncertainty and data or topics related to statistics and probability. While less research on learning obstacles related to mathematical literacy problems that use change and relationship content or related to algebraic material. Whereas algebraic material plays a very important role as a tool for solving advanced mathematical problems, science, business, economics, trade, computing, and other problems in everyday life (Booker, 2009; Sukmawati, 2015). Research on learning obstacles related to mathematical literacy problems should be conducted across a range of mathematics content so that the obstacles related to each student's mathematical literacy across a range of mathematics content can be overcome.

Studies Based on Research Results

This study was conducted to show how learning obstacles related to mathematical literacy problems of students in Indonesia. Learning obstacles can cause a person to have difficulty absorbing abstract concepts, poor memory skills, slow work, and lack of attention to detail. (Sidik dkk., 2021; Solihah et al., 2022). Learning obstacles affect students' mathematical abilities so further assessment and identification of learning obstacles are needed before developing the right didactical design to overcome these learning obstacles (Hidayah et al., 2021).

Terdapat 3 jenis learning obstacle yaitu ontogenical obstacle, epistemological obstacle dan didactical obstacle. After conducting research using the systematic literature review method on the topic of learning obstacles related to mathematical literacy problems, the results of thirteen studies that have been reviewed are as follows:

Table 1. Research Data on learning obstacles related to mathematical literacy problems Based on Research Results

No.	Author (Year)	Types of Learning Barriers	Summary of Research Results
1.	Rahman et al., (2017)	*Epistemological obstacle*	The results showed that in the uncertainty and data content, students have obstacles in reading data on the graph, comparing data, and predicting the value of the next data.
2.	Farisal et al., (2022)	*Epistemological obstacle*	Students experience barriers in understanding mathematical literacy problems on the topic of the perimeter of a quadrilateral, barriers to understanding the purpose of the problem, barriers to mastering the concept of measuring the length and width of a quadrilateral, and barriers to mastering the concept of the perimeter of a quadrilateral.
3.	Nabila et al., (2022)	*Epistemological obstacle*	Some students still experience obstacles related to the connection of the concept of the perimeter of a quadrilateral with everyday life, the ability of the concept of the perimeter of a quadrilateral related to everyday problems, and the use of the formula for the perimeter of a quadrilateral.
4.	Sumirat et al., (2023)	*Epistemological obstacle*	Obstacles were found related to understanding the concept of multiplication on the ranks, understanding the addition operation of power numbers, understanding explaining a^n, understanding solving problems related to ranks, as well as the connection of the concept of power numbers and decimal form.
5.	Hidayah et al., (2021)	*Epistemological obstacle*	Students have difficulty in converting story problems into mathematical modeling, a lack of mastery of the application of algebra in the form of story problems, and difficulty in converting story problems into geometry models.

No.	Author (Year)	Types of Learning Barriers	Summary of Research Results
		Ontogenical obstacle	ignorance and confusion about what to do in completing the test instrument given.
6.	Solihah et al., (2022)	*Epistemological obstacle*	Obstacles related to the connection of the concept of integer division operations with daily life, the concept of distance related to the application from point to point, the relationship between problems and daily life, and the social context related to profit/loss on exchange rates.
		Ontogenical obstacle	Students do not know what to do.
7.	Shabrina et al., (2022)	*Epistemological obstacle*	Students' lack of understanding of the concept of chance used students' lack of understanding of the context of information from the given problem.
		Ontogenical obstacle	Students are less careful in reading the questions and working on them and are not used to working on PISA-type questions.
8.	Rahman, (2017)	*Epistemological obstacle*	In the uncertainty and data content, it was identified that the obstacles were related to students' knowledge in solving problems related to the data presentation material.
		Ontological obstacle	Related to graph complexity.
		Didactical obstacle	Relates to questions of data interpretation and material sequencing.
9.	Mahmudin, (2018)	*Epistemological obstacle*	In the Space and Shape content, obstacles were identified related to students' knowledge in solving problems related to the circle material.
		Ontogenical obstacle	Related to the questions given in the learning process they are too easy and not in accordance with the mental abilities of students.

No.	Author (Year)	Types of Learning Barriers	Summary of Research Results
		Didactical obstacle	Related to the limited context of the questions given to students and the learning flow presented by the textbooks.
10.	Wikara, (2020)	*Epistemological obstacle*	Reflected by students' difficulty in reading and interpreting data on picture diagrams with different contexts.
		Ontogenical obstacle	Reflected in the lack of student motivation and activeness in learning.
		Didactical obstacle	Reflected in the absence of formal definitions related to how to collect and present data and reflected in the lack of assistance from the teacher during the concept construction process.
11.	Farisal, (2022)	*Epistemological obstacle*	Students are only fixated on the known context of the perimeter and area of a rectangular area.
		Ontogenical obstacle	Ontogenic obstacles consist of three categories, namely psychological ontogenic obstacles, instrumental ontogenic obstacles, and conceptual ontogenic obstacles.
		Didactical obstacle	Didactic situations that do not support the learning process of the perimeter and area of a square.
12.	Jelvindo et al., (2022)	*Epistemological obstacle*	Students' conceptual understanding of the material is incomplete.
		Ontogenical obstacle	Students do not understand the prerequisite material.
		Didactical obstacle	The material taught by the teacher is incomplete.

No.	Author (Year)	Types of Learning Barriers	Summary of Research Results
13.	Solihah, (2023)	*Epistemological obstacle*	There are limitations regarding the concept of triangle area, the connection of the concept of base and height in a triangle with the concept of perpendicularity, representing the problem in a picture, the connection of the concept of the perimeter of a triangle with the area of a triangle, and the connection of the perimeter of a triangle with the concept of comparison.
		Ontogenical obstacle	Instrumental ontogenic barriers.
		Didactical obstacle	The presentation of teaching materials does not facilitate students' understanding of the position of the base and height in perpendicular triangles and the lack of practice questions that support the ability of the mathematization process.

Based on Table 2, the results show that epistemological obstacles were found in as much as 100% of all studies, while ontogenically obstacles (obstacles related to students' mental readiness when working on mathematical literacy problems) were found in as much as 69% or 9 studies and didactical obstacles (obstacles related to the methods and approaches used in learning) were found as much as 46% or 6 studies. In Table 2, the average epistemological obstacle experienced by students when solving literacy problems is that most students still experience obstacles to understanding mathematical concepts, applying mathematical concepts, and connecting between mathematical concepts, most students are only fixated on the known context. Then based on Table 2, the average ontogenically obstacle experienced by students when solving literacy problems is that students do not know and are confused about what to do and students do not know and do not understand the prerequisite material besides that students lack interest in mathematics. Furthermore, from Table 2, the didactical obstacles found are the incomplete material taught by the teacher, the presentation of teaching materials that do not facilitate, and the lack of exercises that support mathematical literacy skills.

It can be concluded that students' learning obstacles in solving mathematical literacy problems still need attention to be reviewed or researched. The goal is to make research and development related to mathematical literacy skills considering the importance of these skills for students. This research is expected to provide information to education stakeholders about learning obstacles related to mathematical literacy problems. So in the implementation of mathematics learning at school can pay attention to and improve obstacles or difficulties for students to improve mathematical literacy skills. Then this research is also expected to provide information for further research so that students' mathematical literacy can be developed and improve student learning obstacles related to mathematical literacy in mathematics learning and in solving mathematical literacy problems.

CONCLUSION

Through the systematic literature review method, research on learning obstacles related to mathematical literacy problems has received good attention, especially in detecting epistemological obstacles (obstacles related to incomplete knowledge and understanding that students have so that they have difficulty working on mathematical literacy problems) found as much as 100%, while ontogenically obstacles (obstacles related to students' mental readiness when working on mathematical literacy problems) were found to be 69%, and didactical obstacles (obstacles related to the methods and approaches used in learning) were found to be 46%. The majority of this research was conducted at the junior high school level. This research is also dominated in the Java region on the content of space and shape or closely related to geometry and uncertainty and data or closely related to statistics and probability. This systematic review recommends for educators or researchers identify and fully describe the learning obstacles related to mathematical literacy problems from elementary school, high school, university, and regions outside Java, on content other than space and shape and uncertainty, and data. This research can also help teachers to find the right method, model, or assignment for students to develop and improve students mathematical literacy.

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