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Various Learning Models to Improve Students' Mathematical Literacy Skills

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a b s t r a c t

Mathematical literacy refers to an individual's capacity to understand, formulate, employ, and interpret mathematics in a variety of real-life contexts. It involves not only the mastery of mathematical knowledge but also the ability to reason, solve problems, communicate findings, and use representations and technological tools effectively. This study aims to explore various learning models that contribute to enhancing students' mathematical literacy skills. Using a comprehensive literature review approach, the study analyzes previous research findings related to instructional strategies designed to foster mathematical literacy. The review highlights several effective learning models, including Problem-Based Learning (PBL), guided inquiry, and Project-Based Learning (PjBL). These models share common features such as engagement with authentic, real-world problems, promotion of independent thinking, and facilitation of collaborative learning environments. Through these strategies, students are encouraged to develop critical and creative thinking skills, make meaningful connections between abstract mathematical concepts and their practical applications, and improve their ability to communicate and argue using mathematical reasoning. Moreover, the integration of media and technology within these models supports students in visualizing and solving complex problems. Overall, the study concludes that the implementation of these learning models can significantly enhance students' mathematical literacy and prepare them for problem-solving demands in real-life situations.

K e y w o r d s :
mathematical literacy, learning models, Problem-Based Learning (PBL), Guided Inquiry, Project-Based Learning (PjBL).

INTRODUCTION

Mathematics in schools is not only intended to improve students' numeracy skills, but also to develop logical problem-solving and critical thinking skills. The problem solving in question is not only questions that can be solved by entering numbers into a formula, but also includes analysis and resolution of mathematical problems that are relevant to everyday life. This ability is known as mathematical literacy. Someone who has high mathematical literacy not only understands mathematical concepts, but is also able to apply them to solve everyday problems (Lindawati, 2018).

PISA (Programme for International Student Assessment) is an international organization that measures the mathematical literacy skills of students worldwide. According to the Organization for Economic Co-operation and Development (OECD, 2013), PISA focuses on the skills and competencies acquired by students in school, which must be applied in everyday life and various real situations. Wardhani (in Oktiningrum et al., 2016) stated that mathematical problems as seen in PISA require students to have high-level thinking skills, especially mathematical literacy, by integrating their knowledge in solving mathematical problems.

However, reality shows that Indonesian students' mathematical literacy is still relatively low compared to other countries. Based on the OECD assessment through PISA, Indonesia has consistently ranked in the bottom 10 during the 2009–2018 period (Asmara et al., 2024). The average international score for mathematical literacy is 500, while the average score of Indonesian students only reaches 375, which is the lowest level of the six levels of mathematical literacy set by PISA (Asmara et al., 2024).

Shadiq and Julaiha (in Oktiningrum et al., 2016) stated that the low mathematical literacy of Indonesian students is caused by a lack of habituation in working on mathematical problems that require high-level thinking skills. In addition, students are not yet accustomed to the types of PISA questions that use realistic contexts. Jupri et al. (2013) added that student failure in the PISA survey often occurs at the stage of formulating mathematical problems into formal form. Even after finding the answer, students often do not proceed to the next step to solve the entire problem.

The National Council of Teachers of Mathematics (NCTM, 2000) emphasizes the importance of providing opportunities for students to work on math problems related to other subjects or everyday experiences. This opinion is in line with Mansur (2018) who stated that the low PISA scores are a challenge for Indonesia to find solutions to improve student achievement, especially in students' mathematical literacy skills. One solution that can be applied is to get students used to working on PISA problems or problems that have similar characteristics at each stage of learning. This exercise will train students to get used to working on PISA problems.

In this case, teachers play an important role in choosing an effective learning model that suits students' needs. To improve students' mathematical literacy, a learning model is needed that involves solving real problems, independent exploration of concepts, and collaboration between students. Mansur (2018) stated that teachers need to use a learning model that can activate students, encourage creative and critical thinking, and accustom students to solving problems by inserting mathematical literacy questions at each stage of learning. Mathematics learning must also provide students with experience in solving problems in various situations, in order to improve their mathematical literacy skills (Lindawati, 2018). Fatwa et al. (2019) complement this idea by stating that a learning model is needed that provides space for students to express mathematical ideas, develop thinking skills, and create solutions to problems given by teachers. This model can be used as a basis for consideration in decision-making related to the application of mathematics in the real world, through the stages of the scientific method. Learning that uses problems

as the basis for learning can help students develop deep conceptual understanding, improve critical thinking skills, and connect mathematical concepts to everyday life (OECD, 2019). This is considered important because mathematical literacy develops through the exploration of relevant problems involving the processes of analysis, reasoning, and communication (NCTM, 2000).

This article aims to examine the theories and efforts that can be made to improve students' mathematical literacy skills in mathematics learning. The discussion begins by defining mathematical literacy, identifying its indicators, and exploring ways to improve these skills through the selection of appropriate and effective learning models.

LITERATURE REVIEW

There are fundamental differences between mathematics and mathematical literacy, especially in terms of emphasis on the content and context being studied (Umbara & Suryadi, 2019). Mathematics emphasizes content that contains technical concepts and procedures, while mathematical literacy focuses more on contexts that are practical and lead to real-life applications (Umbara & Suryadi, 2019).

The Ministry of Education and Culture (2017) in the book Supporting Materials for Numeracy Literacy also distinguishes numeracy from mathematics, although both are based on the same knowledge and skills. Mathematical knowledge alone is not enough to guarantee that someone has numeracy skills. Numeracy includes the skills of applying mathematical concepts and principles in everyday situations that are often unstructured, have diverse solutions, or even do not have completely complete answers. In addition, numeracy also involves non-mathematical factors in the solution process.

Based on the above understanding, numeracy according to the Ministry of Education and Culture has similarities with mathematical literacy as referred to in PISA 2012. Mathematical literacy in PISA 2012 is defined as students' ability to formulate, use, and interpret mathematics in various contexts (OECD, 2017). Kusumah (Aini, 2013) explains that mathematical literacy includes the ability to formulate questions, formulate, solve, and interpret problems based on their context. Taunu and Iriani (2019) also stated the same thing, that mathematical literacy is defined as a person's ability to formulate, apply, and interpret mathematics in various contexts, which involves reasoning and the use of mathematical concepts, procedures, facts, and tools to describe, explain, and relate them to everyday life. This is reinforced by Ojose (Surat, 2018) who stated that mathematical literacy is the ability of students to understand and apply several mathematical applications such as facts, principles, operations, and problem solving in everyday life in the past and also the present.

Meanwhile, according to Wardhani and Rumiati (2011), literacy is an absorption of the English word literacy which means the ability to read and write. This is in accordance with the opinion of Abidin et al. (2017) who said that mathematical literacy is closely related to the ability to read and write. However, there is a difference between everyday reading and writing and reading and writing in the context of mathematics. Reading in the context of mathematics refers to the ability to understand mathematical language or read in everyday language related to mathematics, while writing in the context of mathematics refers to the ability to communicate mathematically in writing to convey mathematical understanding and ideas Abidin et al. (2017).

Mathematical literacy begins with realistic problems that are categorized based on context and content. The mathematical literacy process begins by identifying realistic problems and formulating the problems mathematically based on concepts and relationships that are relevant to the existing problems (Oktiningrum et al., 2016). After the problem is formulated into the right mathematical form, the next step is to apply certain mathematical procedures to obtain results that are then reinterpreted into the context of

the initial problem (Oktiningrum et al., 2016). So mathematical literacy is said to involve three main processes, namely formulating, using, and interpreting (Sari, 2015). Mathematical literacy also includes four important components, namely understanding concepts, solving problems, communicating, and applying procedures (Anwar, 2018). Where mathematical literacy is closely related to a person's ability to solve problems in everyday life using mathematical knowledge. The problem-solving process begins with understanding the relevant mathematical concepts to solve the problem. Furthermore, students will formulate the problem into a mathematical form, solve it, and provide an interpretation of the solution found. This process includes various activities such as exploring, connecting, formulating, determining, reasoning, and other mathematical thinking activities that support problem solving.

Mathematical literacy is an individual's ability to understand, formulate, and apply mathematical concepts in the context of everyday life, especially in solving real-life problems. This process involves three main stages, namely identifying the problem, formulating it in mathematical form, and applying mathematical procedures to find a solution that is then linked back to the initial problem. In addition, mathematical literacy includes conceptual understanding, problem-solving skills, the ability to communicate in mathematical language, and the application of mathematical procedures. Thus, mathematical literacy allows individuals to utilize mathematical knowledge effectively in solving everyday problem.

Mathematical Literacy Indicators

According to NCTM (Aritonang & Safitri, 2021), there are five main competencies in mathematics learning, namely mathematical problem solving, mathematical communication, mathematical reasoning, mathematical connections, and mathematical representation. Related to this, the OECD (Tasyanti et al., 2018) states that mathematical literacy includes several indicators, including: (1) mathematical reasoning and thinking; (2) mathematical argumentation; (3) mathematical communication; (4) modeling; (5) delivery of problem solving; (6) representation; (7) symbols; and (8) media and technology. Mathematical reasoning and thinking can be seen from the way students ask mathematical questions, estimate answers, distinguish types of statements, and understand the scope and limitations of mathematical concepts. Mathematical argumentation is reflected in students' understanding of proof, how proof differs from other forms of reasoning, the ability to follow and evaluate chains of arguments heuristically, and the ability to create and convey mathematical arguments. Mathematical communication can be seen from students' ability to express themselves through speech, writing, or other visual forms, and understand how others work. Modeling is reflected in how students organize the area to be modeled, translate reality into mathematical structures, interpret mathematical models in real contexts, work with models, validate models, and reflect on and analyze existing models or solutions. Problem-solving delivery is seen when students convey formulations, definitions, and solutions to problems in various ways. Representation relates to students' ability to encode, translate, differentiate, and interpret various forms of representation of mathematical objects and situations, and understand the relationships between these representations. Symbols relate to students' ability to use symbolic, formal, and technical language in mathematical operations. Finally, media and technology include students' ability to use aids and technology when needed to solve mathematical problems.

In addition, PISA (Fakhriyana et al., 2018) groups mathematical literacy competencies into three categories, namely the reproduction group, the connection group, and the reflection group. In the reproduction group, students are able to interpret and represent familiar problems, as well as perform simple calculations and procedures to solve routine problems. In the connection group, students can integrate and connect various content

situations and representations to solve non-routine problems, using simple mathematical reasoning methods. While in the reflection group, students can solve more complex problems, develop mathematical ideas, and use more complicated methods to make generalizations in problem solving.

Mathematical literacy indicators include various competencies that enable students to understand and apply mathematics in various contexts. This includes mathematical thinking and reasoning skills, argumentation, mathematical communication, modeling, problem-solving delivery, representation, use of symbols, and utilization of media and technology. Mathematical literacy is also divided into three categories based on the level of difficulty: the reproduction group (solving simple and routine problems), the connection group (connecting and integrating concepts to solve non-routine problems), and the reflection group (solving complex problems and making generalizations using various mathematical methods)..

Learning Models Assessed to Improve Mathematical Literacy

Mathematical literacy is more than just following procedures to solve a problem or issue. Ojose (Firdaus et al., 2021) states that mathematical literacy includes the knowledge, competence, and confidence that a person has to apply mathematical knowledge in dealing with real problems. A person who has good mathematical literacy skills is able to estimate, interpret data, solve everyday problems, and think in numerical, graphical, and geometric contexts, and can communicate using mathematics. Problem-solving, information processing, and communication skills as part of mathematical literacy skills are important skills in completing routine tasks in everyday life. Mathematical literacy is very important both in the world of work and in everyday life, so having good mathematical literacy skills is as important as reading and writing skills.

To achieve a good level of mathematical literacy, students not only need to understand the indicators of mathematical literacy, but also have the confidence to use these problem-solving ideas (Firdaus et al., 2021). Therefore, teachers need to teach mathematics in such a way that students can have good mathematical literacy skills, as a result of understanding the concepts that have been learned to be used in solving real-world problems. In addition, the material taught in mathematics learning must be relevant to the problems that exist in society, so that students no longer feel confused about how the mathematical material they learn can be applied in their lives (Firdaus et al., 2021).

The process of mathematical literacy begins with identifying contextual problems, then formulating them in mathematical form based on concepts and relationships relevant to the problem. After the problem is converted into mathematical form, the next step is to apply mathematical procedures to obtain appropriate results. This stage generally involves activities such as manipulation, reasoning, and calculation. The mathematical results obtained are then reinterpreted to relate them to the initial problem. In each process of formulating, applying, and interpreting problems, basic mathematical abilities will be activated sequentially, depending on the relevant mathematical content to achieve a solution (Anwar, 2018). In addition, Kilpatrick, J., Swafford, J., & Findell, B. (2001) stated that mathematical literacy includes five dimensions, one of which is reasoning and problem-solving abilities. By providing complex problems, students are trained to think critically and reflectively (Kilpatrick et al., 2001). Through problem solving, students learn to formulate questions, develop strategies, and reflect on solutions, which are key components of mathematical literacy (Polya, 1957). Mathematical literacy can be enhanced by exploring contextual problems that require students to use a variety of mathematical strategies (Van de Walle, Karp, & Bay-Williams, 2013).

Mathematical literacy is different from simply mastering mathematical concepts, because mathematical literacy emphasizes more on how students are able to apply mathematical

knowledge in real-life contexts (Lindawati, 2018). Several theoretical frameworks emphasize that learning models that support active and collaborative exploration activities can improve mathematical analysis, communication, and problem-solving skills (Utami, 2018). This is reinforced by the results of research conducted by Jannah et al. (2021), Maysarah (2015), (Hamidah et al., Noviyana & Sugianti, 2024), Huda and Khotimah (2023), Firdaus et al. (2021), Hidajat et al. (2019), Roza et al. (2018), and Dinata (2022) that the Problem Based Learning (PBL) and PjBL models are based on the principle of learning through real problems that encourage students to think critically and independently in formulating solutions. Meanwhile, research conducted by Wahyuni and Rusnilawati (2024), Ramlin et al. (2019), and Buyung and Dwijanto (2017) showed that the guided inquiry model emphasizes the process of exploration and independent discovery of science by students, which will strengthen their scientific foundations and scientific attitudes. This theoretical basis is in accordance with the view that developing literacy skills requires empowering students to recognize real contexts and apply solutions innovatively.

METHODS

Population and Sample

The population in this study includes all scientific publications that discuss mathematical literacy and learning strategies used to improve it. From this population, researchers took purposive samples, namely journals and books that meet certain criteria, such as: Published in the last ten years. Relevant to the topic of mathematical literacy and mathematical learning models, and have a strong empirical or theoretical approach.

Research Design

This study uses a literature review method as the main research design. Literature reviews are conducted by collecting and analyzing relevant literature sources, such as scientific journal articles, reference books, and research reports that discuss mathematical learning models and their effects on improving students' mathematical literacy. The main focus is on journal articles published in the last ten years, to ensure the relevance and actuality of the data studied. The selection of this method is based on the aim of compiling an in-depth and comprehensive theoretical study as the basis for the analysis and conclusions of this study.

Frame Work Flow

The workflow of this research follows a systematic structure that starts from identifying problems and formulating objectives, followed by collecting literature, selecting sources based on certain criteria, then conducting content analysis, and ending with drawing conclusions based on theory. Schematically, the flow of this literature review can be explained as follows:

1. Identification of topics and scope of mathematical literacy,
2. Collection and selection of journals and reference books,
3. Classification of learning models based on their effectiveness in the literature,
4. Synthesis and critical analysis of literature findings,
5. Drawing conclusions and recommendations for further research.

Research Design, Site, and Participants

Since this study is qualitative based on literature review, it does not involve participants or research locations directly. The research subjects in this context are scientific

documents and publications that are selected purposively based on certain criteria, such as relevant topics, journal quality, and publication time. The criteria for selecting literature include national and international accredited journals that discuss innovative learning models in the context of students' mathematical literacy. Thus, the characteristics of "participants" referred to in this study refer to the characteristics of written sources, not individual or group of respondents.

Data Collection and Analysis

The data in this study were collected through a secondary source search process, which included journal articles, academic books, and research reports that can be accessed through databases such as Google Scholar, ScienceDirect, and DOAJ. The search procedure was carried out with certain keywords such as "mathematical literacy", "learning models in mathematics", and "effective mathematical learning". The collected data were then analyzed using a content analysis approach, to identify the main themes, research gaps, and conclusions from the various studies analyzed.

The analysis was conducted systematically by examining the arguments, findings, and relevance of the theories used by each author. The researcher's competence in assessing the quality of articles and compiling information synthesis is an important aspect in the validity of the analysis.

RESULT AND DISCUSSION

Mathematical literacy is an individual's ability to understand, interpret, and use mathematical concepts and procedures effectively in a variety of real-life situations. This ability includes not only mastery of mathematical theory, but also skills in applying it to solve everyday problems, both in personal, social, and professional contexts.

The process of mathematical literacy involves three main stages, namely: (1) identifying and understanding problems in real contexts, (2) translating problems into mathematical models or representations, and (3) using mathematical reasoning and procedures to find solutions, which are then reinterpreted into the original context of the problem.

In addition, mathematical literacy includes various important skills, including: understanding basic mathematical concepts, developing logical and systematic problem-solving strategies, thinking critically and reflectively in evaluating solutions, and communicating using symbols, graphs, or mathematical language clearly. This ability also involves the use of tools and technology in solving mathematical problems efficiently.

By having good mathematical literacy, a person can think rationally, make the right decisions, and face challenges in the complex information era. This literacy is an important foundation in forming a society that is literate in numbers, thinks logically, and is able to make data-based decisions in various aspects of life.

Mathematical literacy according to various sources consists of a number of core competencies, such as reasoning, argumentation, communication, modeling, representation, use of symbols, and utilization of media and technology. These competencies enable students to understand, communicate, and apply mathematics meaningfully in various real contexts. In addition, mathematical literacy skills can be grouped into three levels, namely reproduction (solving routine and simple problems), connection (connecting and integrating concepts to solve non-routine problems), and reflection (solving complex problems and making generalizations through various mathematical approaches).

Therefore, it is very important for teachers to choose a learning model that encourages students to express mathematical ideas, develop thinking skills, and be given space to

formulate and solve problems as a basis for decision making. Learning must be designed in such a way that students are actively involved in every stage of the scientific process, with mathematical problems presented according to real situations faced every day. This is in line with the approach used in PISA questions, which emphasizes the application of mathematics in real life. The following are some learning models that are considered capable of improving mathematical literacy skills.

1. Problem Based Learning (PBL) Learning Model

One of the learning models that provides many opportunities for students to express mathematical ideas and develop their thinking skills in order to improve learning achievement, especially in improving mathematical literacy skills, is the Problem Based Learning (PBL) model (Hidajat et al., 2019). According to Arends (Trianto, 2007), PBL is a learning model that focuses on authentic problems that allow students to construct their own knowledge, develop high-level skills, and foster independence and questioning skills. Schmidt (Huda and Khotimah, 2023) explains that PBL is based on the theory of constructivism which first encourages understanding through interaction with problem scenarios and learning environments. The process of grappling with problems creates cognitive tension that stimulates the learning process, and knowledge is formed through social collaboration and evaluation of existing perspectives. Stepien et al. (Ngalimun, 2014) also stated that PBL is a learning model that involves students in solving problems through the stages of the scientific method, so that students can learn knowledge relevant to the problem while developing problem-solving skills. Dzulfikar (2012) added that PBL helps students construct their own knowledge, develop higher skills, and increase their independence and self-confidence.

According to Firdaus et al. (2021), PBL can be used to improve students' mathematical literacy for several reasons, such as: 1) providing problems related to real life, 2) encouraging active student involvement in learning, 3) encouraging the use of various learning approaches, 4) providing opportunities for students to actualize their abilities, 5) creating collaborative learning, and 6) helping to achieve quality education. Supported by the advantages of PBL according to Sanjaya (Octaria et al., 2018), including: 1) helping students understand the subject matter, 2) training students to solve problems that challenge their abilities, 3) making students active in learning, 4) helping students form knowledge to solve real problems, 5) forming a sense of responsibility for students in groups, 6) encouraging students to evaluate the knowledge they have learned, 7) making students enjoy learning, and 8) providing opportunities for students to apply their knowledge in the real world.

Based on the explanation above, it can be concluded that PBL is a learning model that involves students in solving real problems that are relevant to their lives. PBL emphasizes learning through problems that do not have a single answer, providing opportunities for students to develop mathematical literacy skills continuously, through understanding problems, applying formulas, and analyzing data. PBL aims to provide students with independence in learning, independent learning habits, questioning skills, and problem solving. PBL also facilitates simulations of real-life situations and encourages students to learn individually through research, which ultimately helps them get used to solving real problems. Therefore, the entire series of PBL models can improve students' mathematical literacy skills, especially if the problems presented in mathematics learning are related to everyday life, as reflected in PISA questions.

Various studies such as those conducted by Huda and Khotimah (2023), Firdaus et al. (2021), Hidajat et al. (2019), Roza et al. (2018), and Dinata (2022) show that the use of the PBL model can improve students' mathematical literacy skills. These studies support this theory, by showing a positive relationship between the application of the PBL model and improving students' mathematical literacy skills, especially if the problems presented in

mathematics learning are linked to real problems in everyday life, as reflected in PISA questions.

2. Guided Inquiry Learning Model

The guided inquiry learning model is a learning model that aims to teach students the basics of scientific thinking, encourage students to learn independently, and develop creativity in solving problems (Fathurrohman, 2015). Sukmawati concluded that this model involves students' activeness in exploring and discovering their own knowledge (Nuayi & Very, 2020). This model provides students with the opportunity to learn to discover facts, concepts, and principles through direct experience. Thus, students do not only learn by reading or memorizing material, but also have the opportunity to hone their scientific thinking skills and attitudes. This process allows students to build their knowledge constructively, which in turn improves their understanding of the material being studied (Ramlin, 2019).

In the context of this study, the guided inquiry learning model includes steps that help students to investigate and solve problems systematically, critically, and logically. These steps include planning, collecting information, processing information, creating information, communicating information, and evaluating. This model prioritizes the active involvement of students in the process of investigation and discovery, allowing them to develop a deeper understanding of the concepts being taught. Supported by the main advantage of the inquiry learning model, namely the ability to overcome learning that tends to be passive, through activities such as reading, observing, and working together in groups, students can stimulate their critical thinking skills and accelerate their understanding of the subject matter. Song & Looi (Buyung & Dwijanto, 2017) stated that the guided inquiry learning model makes students more independent in formulating problems, finding sources of information, planning procedures, and formulating their own solutions. Thus, learning becomes more enjoyable and students find it easier to understand the material being studied.

In implementing this model, teachers often use scaffolding strategies to provide assistance to students who are having difficulties. Through this guidance, students are given the support they need to overcome obstacles in the learning process, so that they can continue to develop their thinking and problem-solving skills independently. This model also requires students to think creatively and communicate their ideas in solving problems independently. The math problems given in this model are based on everyday situations that are close to students' experiences and are adjusted to the characteristics of the problems in PISA. Students are not only required to read or memorize, but to understand the problem in depth, stimulate critical thinking skills, and find solutions through questions and investigations. Students are given problems that require investigation to find solutions, which can involve experiments or data analysis. Through this process, students' mathematical literacy can develop, because they interact directly with mathematical concepts in a more open context.

Research conducted by Wahyuni and Rusnilawati (2024), Ramlin et al. (2019), and Buyung and Dwijanto (2017) showed that the application of the guided inquiry learning model has a positive influence on improving students' mathematical literacy skills. This model has been proven effective in encouraging students to develop mathematical skills, think critically, and solve problems in real-life contexts, which can ultimately improve students' overall mathematical literacy competencies.

3. Project Based Learning Model (PjBL)

One way to help students improve their mathematical literacy skills is to use a project-based learning (PjBL) model. According to Ngalimun (Maysarah et al., 2023), this type of learning allows students to develop skills that are relevant to the real world while

preparing them for future careers. This model provides opportunities for students to explore and solve problems while still focusing on their interests and needs. Project-based learning also provides opportunities for teachers to manage learning by involving students in working on projects that involve complex tasks, which are based on real problems. This project aims to collect and integrate new knowledge based on students' experiences in practical activities (Husna, Mariyam, and Maudi, 2016). This means that PjBL requires students to complete projects both individually and in groups, and the results of the project are presented in front of the class.

Patton (Utami & Nirawati, 2018) explains that PjBL includes student activities that include designing, planning, and completing projects that produce products that can be presented to the public. The learning process in this model has advantages because learning becomes more interesting and varied, which helps students understand the material more easily (Nurfitriyanti, 2016). Activities that are structured around the project will increase the effectiveness of learning and help students remember what they have learned (Anggraini & Wulandari, 2020). PjBL is a student-centered learning model that integrates real-world problems. In this model, students play an active role, while teachers provide the support needed (Ratnasari, Tadjudin, Syazali, Mujib, & Andriani, 2018).

Research conducted by Utami (2018) shows that mathematical literacy can be improved through a scientific and realistic approach using a project-based learning model, with PISA-based measurements. Jannah et al. (2021) also found that the project-based learning model is very suitable for improving mathematical literacy because students not only learn theory but also gain practical experience in the real world. In addition, Maysarah's research (2015) shows that PjBL can improve students' communication skills and creative mathematical thinking skills as part of the abilities underlying mathematical literacy skills. This model not only improves students' knowledge in learning mathematics but also develops other skills (Hamidah et al., Noviyana & Sugianti, 2024).

In the implementation of PjBL, teachers usually start by giving a little theory first, then presenting real problems to students. After that, students are asked to create a project based on the problem. This approach has proven effective in increasing students' interest and enthusiasm for mathematics, especially in solving problems related to mathematics. By using PjBL, students have the freedom to express their ideas and creativity in the projects they design. In addition, they can also confidently present the concepts they have discovered through the project in front of friends and teachers. So the stages in the PjBL model are believed to be able to significantly improve students' mathematical literacy skills. This is because PjBL provides opportunities for students to learn actively and be directly involved with real problems. By working on projects that integrate mathematics, students can more easily understand mathematical concepts and apply them in real-world situations. This is in accordance with the core of mathematical literacy which emphasizes the importance of using mathematics in real contexts, such as those found in PISA questions.

CONCLUSION AND IMPLICATION

Conclusion

Mathematical literacy is a person's ability to understand, formulate, and apply mathematical concepts in everyday life, especially in solving realistic problems. This process involves three main steps, namely identifying problems, changing them into mathematical form, and using mathematical procedures to find solutions that are then linked back to the initial context of the problem. In addition, mathematical literacy also

includes conceptual understanding, problem-solving skills, mathematical communication skills, and the application of appropriate mathematical procedures. Thus, mathematical literacy helps everyone to use their mathematical knowledge to solve various challenges in life effectively.

The main indicators of mathematical literacy include the ability to think mathematically, solve problems, communicate mathematically, represent concepts, build arguments, and utilize media or technology. Mathematical literacy is divided into three categories based on the level of difficulty: the reproduction group (overcoming simple and routine problems), the connection group (integrating and connecting concepts to solve non-routine problems), and the reflection group (solving complex problems and making generalizations through various mathematical approaches).

Given the importance of mathematical literacy skills, teachers need to choose learning models that support students to develop these skills. A good learning model allows students to express their mathematical ideas, hone their thinking skills, and be given the opportunity to develop problems posed by the teacher as a basis for decision-making in the application of mathematics in real life as seen in mathematical literacy skills. Teachers also need to design learning that actively involves students in asking questions, discussing, and finding solutions independently or in groups. Various learning models can be used to encourage students to express their mathematical ideas and use the process of identifying mathematical problems as a first step in understanding concepts or materials. This can ultimately improve students' mathematical literacy skills. These learning models can be applied at every stage of mathematics learning, by adjusting the problems presented to real situations faced every day, as reflected in PISA questions. Some of the learning models in question include problem-based learning, guided inquiry, and project-based learning.

That learning models are effective in improving students' mathematical literacy skills because with these learning models, students are directed to focus on contextual problems or real problems in everyday life. Where this will help students learn to understand and analyze real problems which are the core of mathematical literacy. This model also encourages the use of high-level thinking skills, such as conceptual understanding, mathematical communication, and problem solving which are important elements in mathematical literacy. This is because mathematical literacy is not only about problem solving, but also how students are able to understand, interpret, and communicate mathematical ideas. In addition, this learning model provides space for students to develop questioning skills which are the first step in exploring and understanding concepts in depth. Students are encouraged to ask questions such as "What is the problem?", "What is the best way to solve it?", and "Is the chosen solution the most effective?". This habit of asking questions is very important because it helps students develop critical, reflective, and analytical thinking skills which all support the strengthening of mathematical literacy.

The three learning models have in common that they involve real-world problem solving, independent exploration of concepts, and collaboration between students that can improve students' mathematical literacy. The application of these models encourages students to think critically, creatively, and better understand the relationship between mathematics and everyday life, which ultimately improves their mathematical literacy skills. By

implementing learning models that are integrated with contexts and problems in everyday life, students not only learn mathematics as a discipline, but also understand how mathematics is a relevant tool for facing challenges and making decisions in real life.

Implication

The results of this study indicate that the application of contextual problem-based learning models, such as Problem Based Learning (PBL), guided inquiry, and Project Based Learning (PjBL), has great potential in improving students' mathematical literacy. The main implications of these findings for educational practice and curriculum development are as follows:

1. Strengthening the contextual approach in mathematics learning, where teachers are advised to design learning that integrates real problems from everyday life so that students are able to understand the relevance of mathematics in the context of the real world, thereby increasing their interest and analytical skills.
2. The use of project-based learning models and guided inquiries that can improve high-level thinking skills, such as analysis, communication, and problem solving, which are very important for improving students' mathematical literacy.
3. Training and application of technology in learning the use of media and technology such as online platforms and interactive applications is highly recommended to support distance learning and enrich students' learning experiences, so that they are more active and creative in expressing mathematical ideas.
4. It is necessary to develop assessment instruments that are able to measure aspects of mathematical literacy holistically, including mathematical argumentation, representation, and communication skills, in accordance with the characteristics of PISA competencies.
5. It is necessary to adjust the curriculum by emphasizing the strengthening of practical and contextual aspects in mathematics learning that can train students' mathematical literacy competencies in a sustainable manner.

By implementing these findings consistently, it is hoped that the mathematical literacy competencies of Indonesian students can increase, which will ultimately support the achievement of national education targets and their preparation in facing global challenges.

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