SigmaMu 4(1) (2026)

Journal of Mathematics, Statictics and Data Science

https://journals.balaipublikasi.id

An analysis of mathematical literacy skills in solving pisa mathematics problems among students of smpn 13 mataram in the academic year 2024/2025

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Received: 03-09-2025
Revised: 05-03-2026
Accepted: 11-03-2026

DOI:
https://doi.org/10.56566/sigmamu.v4i1.435

Abstract: This study aims to analyze mathematical literacy skills in solving PISA mathematics questions based on the level of mathematical literacy skills among students at SMPN 13 Mataram in the 2024/2025 academic year. This is a descriptive qualitative study involving 52 students from classes IX A and IX B, with 8 students selected as subjects. The research instruments used were a mathematics literacy test adapted from PISA and interview guidelines. Data were analyzed based on mathematics literacy process indicators (formulate, employ, interpret). The results showed that out of the 6 levels of mathematical literacy, no students reached levels 5 and 6. At level 1, students could formulate explicit information and solve problems using simple algorithms, at level 2, they could identify implicit information and select basic strategies to solve problems; at level 3, they could process complex explicit information containing distractors and develop sequential strategies for decision-making, while Level 4 can formulate explicit information in everyday contexts and apply strategies to complex concrete situations. Students at Levels 1-4 also have the ability to interpret and draw conclusions based on the context of the problem.

Keywords: *Mathematics Literacy, PISA, concrete, complex, Junior High School Students*

Introduction

Programme for International Student Assessment (PISA) is a program from *Organization for Economic Cooperation and Development* (OECD) for international student assessment. PISA is conducted every three years. PISA measures the ability of 15-year-old students to use reading, mathematics, and science skills to face real-life challenges. PISA's focus in mathematics is on mathematical literacy (Laksari, Sridana, Tyaningsih, & Hikmah, 2023). Mathematics learning is a teaching and learning process built by teachers to develop students' creative thinking and can improve their ability to construct new knowledge as an effort to improve mastery of mathematics material (Susanto A, 2016). PISA 2022*Assessment and Analytical Framework* defineMathematical literacy is an individual's ability to think mathematically and formulate, use, and interpret mathematics to solve problems in a variety of real-world contexts (OECD, 2023). This ability includes

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the ability to reason mathematically and understand concepts, procedures, and facts as tools for analyzing and predicting events in diverse contexts (Anggreani & Hakim, 2024). Mathematical literacy is a student's ability to formulate, use, and interpret mathematics in various contexts, including the ability to reason mathematically (Serang, Yusuf, & Aba, 2024).

Mathematical literacy skills can help individuals make informed decisions. This demonstrates the ability to formulate, apply, and interpret mathematics in various situations, which aids decision-making and fosters higher-order thinking. According to Qadry, Dassa, & Aynul (2022), the literacy skill indicator encompasses three assessment aspects: 1)*formulate* (formulate), 2)*employ* (implement), 3)*interpret*(interpreting). According to Nolaputra, Wardono, & Supriyono (2018) there are seven components in mathematical literacy, namely: communication, mathematization, restating, reasoning and giving reasons, using problem-solving strategies, using symbols, formal language and techniques, and using mathematical tools.

Based on the PISA report MINISTRY OF EDUCATION, CULTURE, RESEARCH AND TECHNOLOGYThe 2022 PISA results saw a decline in international learning outcomes due to the pandemic. For mathematical literacy, Indonesia's ranking in PISA 2022 rose 5 places compared to PISA 2018. Indonesia's score on the international mathematical literacy test in PISA 2022 decreased by an average of 21 points. Indonesia's score decreased by 13 points, better than the international average in PISA 2022 (Ministry of Education and Culture, 2023).

Based on *student performance* In PISA 2022, only 18% of Indonesian students achieved level 2 proficiency in mathematics, significantly lower than the average for all OECD countries, which is 69%. Students at this level can interpret and recognize simple situations that can be represented mathematically. Almost no Indonesian students achieved the highest achievement in mathematics, meaning they reached level 5 or level 6 on the PISA 2022 mathematics test.

Based on interviews with mathematics teachers at SMPN 13 Mataram on May 21, 2024, it was found that students' mathematical literacy skills were still relatively low, and their ability to solve mathematical problems or questions was also low. This was confirmed by the results of a trial test of students' mathematical literacy skills, where only two students were able to answer question number one with the appropriate indicators. Many more students were unable to complete the assigned questions.

SMPN 13 Mataram has conducted a PISA trial. The activity went well and smoothly, however, the results of the PISA trial were directly submitted to the Ministry of Education and Culture so there is no clear information regarding the mathematical literacy skills of students at SMPN 13 Mataram. Because SMPN 13 has conducted a PISA trial, SMPN 13 can represent schools in mathematical literacy and there has been no further research to identify the level of students' mathematical literacy skills and focus more on the general causes of the decline in national scores so that there is a lack of specific analysis of students' mathematical literacy skills in solving PISA mathematics problems based on process indicators (*formulate, employ*, *interpret*).

Based on the above explanation, considering the importance of mathematical literacy skills, a study entitled "Analysis of Mathematical Literacy Skills in Solving PISA Mathematics Problems for Students of SMPN 13 Mataram in the 2024/2025 Academic Year" is necessary. This study aims to describe the mathematical literacy skills in solving PISA mathematics problems based on the level of mathematical literacy skills of students of SMPN 13 Mataram in the 2024/2025 Academic Year.

Method

This research is a descriptive qualitative study, as it aims to understand events by describing them using words to understand students' mathematical literacy skills. This research was conducted in the even semester of the 2024/2025 academic year at SMPN 13 Mataram. This study involved 52 students in grades IX A and IX B, and then eight students were selected as research subjects.selected based on the level of students' mathematical literacy abilitiesthen analyzed.

The data collection techniques in this study were tests and interviews, and the instruments used were mathematical literacy ability tests and interview guidelines that had been declared valid

by 5 validators consisting of 2 lecturers from the Mathematics Education Faculty of the University of Mataram and 3 mathematics teachers from SMPN 13 Mataram. The validity test used was content validity, which was calculated based on the index.*V* by Aiken's (Jalal & Afandi, 2017). Based on the index*V*According to Aiken's, the validity value of the mathematical literacy test instrument is 0.8, indicating that the test instrument is in the valid category. This study used a data credibility test to verify the validity of the data. The credibility test used was triangulation. Thus, there is source triangulation, technical triangulation, data collection triangulation, and time (Sugiyono, 2018). The triangulation used was technical triangulation. To test credibility with technical triangulation, data was checked against the same source using different techniques. Data was obtained through tests, then checked through interviews and observations.

The mathematical literacy test questions used were adapted from PISA questions and adjusted to student abilities. The test questions covered six levels of mathematical literacy. Data analysis in this study was conducted based on the mathematical literacy process, which was assessed based on each student's level of ability and grouped by level of mathematical literacy.

Adapted PISA Mathematical Literacy Questions

1. PISA *main survey new mathematics items* 2022

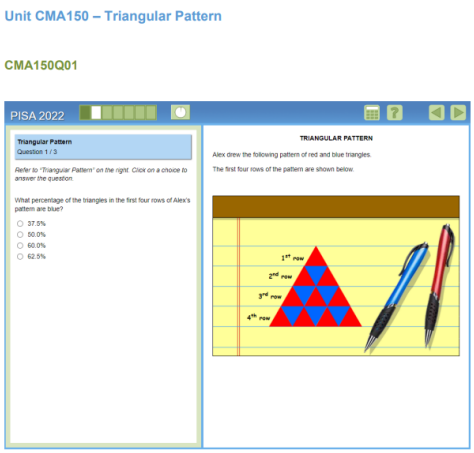

Figure 1. PISA *main survey new mathematics items* 2022

2. PISA *main survey new mathematics items* 2022

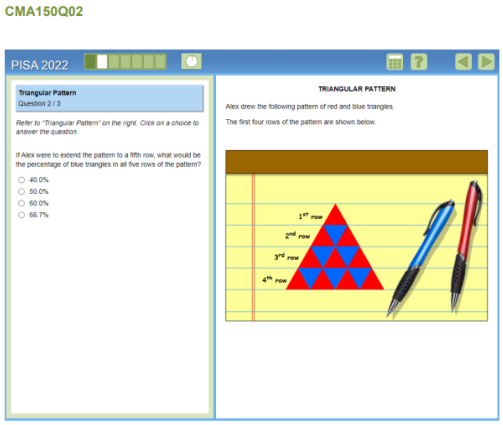

Figure 2. PISA *main survey new mathematics items* 2022

3. PISA 2012 *items*

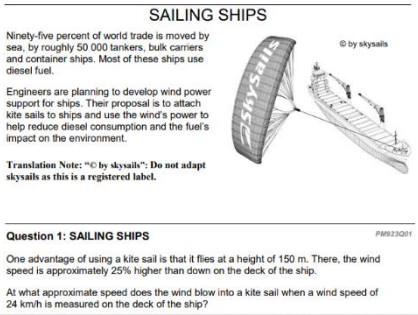

Figure 3. PISA 2012 *items*

4. PISA 2012 *items*

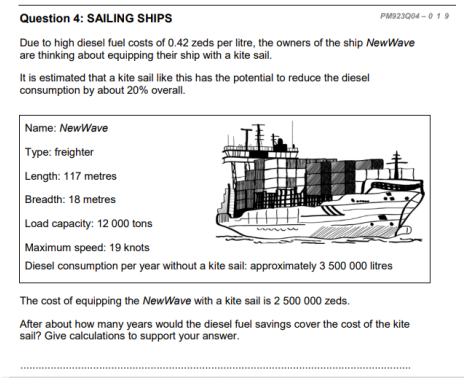

Figure 4. PISA 2012 *items*

5. PISA *take the test sample questions from OECD's PISA assessments 2009*

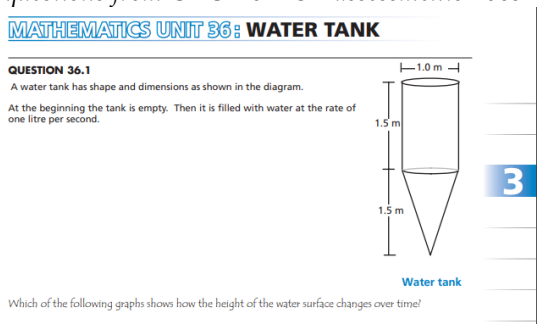

Figure 5. PISA *take the test sample questions from OECD's PISA assessments 2009*

6. PISA *main survey new mathematics items* 2022

Figure 6. PISA *main survey new mathematics items* 2022

Result and Discussion

The mathematical literacy test questions given to grade IX students of SMPN 13 Mataram in the 2024/2025 academic year consisted of 6 essay questions adapted from the PISA mathematical literacy test questions. Based on the analysis of students' answers according to their mathematical literacy level, the students' mathematical literacy level can be seen in graph 1:

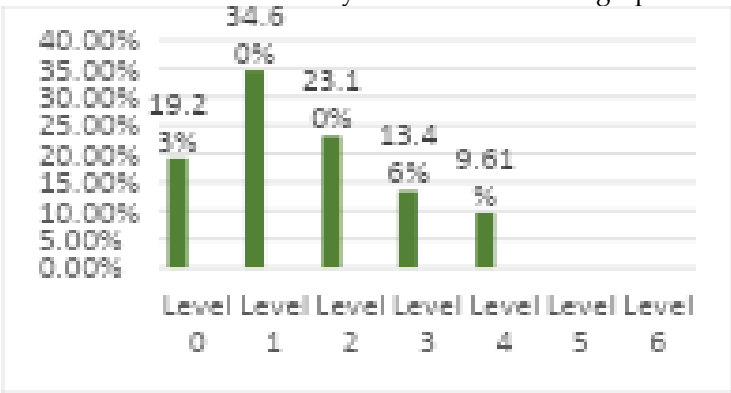

Figure 7. Level of students' mathematical literacy skills

Of the total 52 students, the majority of students are at level 1, namely 34.61% or 18 students, followed by level 2 with 23.07% or 12 students, while students who did not reach level 1 were 19.23% or 10 students. Only a few students reached level 3, namely 13.46% or 7 students and students who

reached level 4 were 9.61% or 5 students, while none of the students reached level 5 or level 6. So an analysis of students' mathematical literacy abilities was carried out from level 1 to level 4.

In the process aspect*formulate*, level 1 students are able to write and explain explicit information in the form of the number of balls in the box correctly. Level 1 students are not yet able to write implicit information in the form of number patterns at level 2 even though they write level 2 answers. Level 2 students are able to write and explain implicit information in the form of number patterns in a row correctly. Level 2 students are not yet able to write complex explicit information with distractors in the form of the height of a ship's kite at level 3 even though they write level 3 answers.

Level 3 students are able to write and explain complex explicit information with a distractor in the form of the height of a ship's kite correctly. These students are not yet able to write information contained in level 4 which is explicit information related to daily life even though they wrote the answer for level 4. Level 4 students are able to write and explain explicit information related to daily life in the form of fuel consumption and its price correctly. This is related to one aspect of the mathematical literacy process, namely mathematization, according to Abidin.,Mulyati & Yusanah(2018) mathematization is the ability to change problems in a real-world context into mathematical sentences or interpret the results of solutions or mathematical models into a real-world context.

On the aspect *employ*, level 1 students are able to perform mathematical calculations with simple algorithms according to the needs of the problem correctly. Level 1 students are not yet able to choose a simple strategy, develop a solution strategy that requires sequential decision-making, and apply strategies to complex concrete situations even though they write answers for levels 2 to level 4. Level 2 students are able to perform calculations by selecting and applying simple strategies to solve problems correctly at level 2. Level 2 students are not yet able to develop a solution strategy that requires sequential decision-making, and apply strategies to complex concrete situations even though they write answers for levels 3 and level 4.

Level 3 students are able to perform calculations by developing solution strategies that require correct sequential decision-making. Level 3 students are not yet able to select and apply strategies for complex concrete situations even though they write answers for level 4. Level 4 students are able to perform solutions by selecting and applying strategies for complex concrete situations correctly in solving level 4 problems. This is related to one aspect of the mathematical literacy process, namely strategies for solving problems. Mathematical literacy requires the ability to select or use various strategies in applying mathematical knowledge to solve problems (Abidin et al., 2018).

On the aspect *interpret*, level 1 students are able to interpret and summarize the results back into the context of the given blue ball percentage problem correctly. Level 1 students have not been able to interpret and summarize the results back into the context of the problem at level 2, namely being able to interpret and summarize the results back into the context of the problem of the percentage of blue triangles in the five number row patterns, level 3, namely being able to interpret and summarize the results back into the context of the problem of estimating ship speed, level 4, namely being able to interpret and summarize the results back into the context of the problem of cost savings for one year. Level 2 students are able to interpret and summarize the results back into the context of the problem of the percentage of blue triangles in the fifth pattern given correctly, but have not been able to interpret and summarize the results back into the context of the problem at level 3, namely being able to interpret and summarize the results back into the context of the problem of estimating ship speed, level 4, namely being able to interpret and summarize the results back into the context of the problem of cost savings for one year.

Level 3 students are able to interpret and summarize the results back into the context of the given ship speed estimation problem correctly. Level 3 students are not yet able to interpret and summarize the results back into the context of the problem at level 4, namely being able to interpret and summarize the results back into the context of the problem of cost savings for one year. Level 4 students are able to interpret and summarize the results back into the context of the given fuel

savings problem correctly. This is related to one aspect of the mathematical literacy process, namely representation. Mathematical literacy involves the ability to represent an object and a mathematical situation through the activity of selecting, interpreting, translating, and using various forms of representation to present a situation (Abidi et al., 2018).

Based on the analysis of mathematical literacy skills, students were able to complete level 1 correctly and demonstrated a good basic understanding in solving simple mathematical problems. This is in line with research by Sriningsing, Sarjana, Hayati, & Prayitno (2022) that found that students' mathematical literacy skills were at level 1, where students were only able to operate mathematics in simple contexts. Students' achievement at level 1 was demonstrated by the research subjects' ability to go through three aspects of the mathematical literacy process.

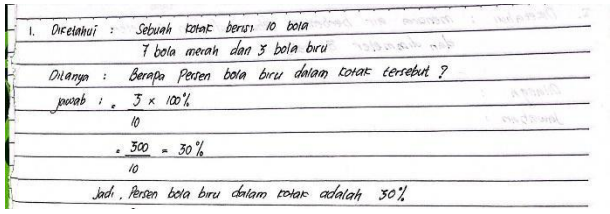
1. Diketahui : Sebuah kotak berisi 10 bola
7 bola merah dan 3 bola biru
Ditanya : Berapa Persen bola biru dalam kotak tersebut ?
jawab : $\frac{3}{10} \times 100\%$
$= \frac{300}{10} = 30\%$
Jadi, Persen bola biru dalam kotak adalah 30%

Figure 8. Level 1 student answers

Students' mathematical literacy level 2 is defined as being able to complete level 2 tasks correctly and demonstrating good ability to select simple strategies for solving them. According to the 2022 PISA Indonesia results, 18% of Indonesian students reached level 2. These students can interpret and recognize without direct instruction and represent simple mathematical strategies to solve problems. Students' ability to achieve level 2 mathematical literacy is demonstrated by the research subjects' ability to correctly go through three aspects of the mathematical literacy process. Students are able to find simple patterns in problems by selecting simple strategies, thus having the ability to explore and reason logically to solve problems. This aligns with the definition of mathematical literacy according to*National Council of Teachers of Mathematics* (NCTM) namely mathematical literacy means an individual's ability to explore, make predictions, and reason logically and use various mathematical methods effectively to solve problems (Sari, 2015).

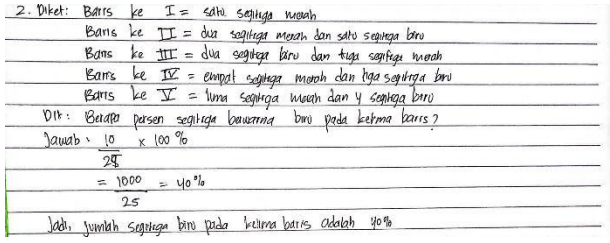
2. Diket: Baris ke I = satu segitiga merah
Baris ke II = dua segitiga merah dan satu segitiga biru
Baris ke III = dua segitiga baru dan tiga segitiga merah
Baris ke IV = empat segitiga merah dan tiga segitiga biru
Baris ke V = lima segitiga merah dan 4 segitiga baru
Dit: Berapa persen segitiga berwarna biru pada kelima baris ?
Jawab : $\frac{10}{25} \times 100\%$
$= \frac{1000}{25} = 40\%$
Jadi, jumlah segitiga biru pada kelima baris adalah 40%

Figure 9. Level 2 student answers

The mathematical literacy ability of students at level 3 is able to work on level 3 correctly, this is in line with the research of Sabrina, Puspadewi, & Noviyanti (2023), as many as 10 students were able to solve level 3 problems well, where students were required to apply strategies in solving problems. Students also showed good abilities in solving problems that require sequential thinking strategies or sequential implementation of procedures. According to Jamaesa, Prayitno, wahidaturrahmi, & Hapipi (2022), students are predominantly at level 2 and level 3, which means students are able to apply basic algorithms, formulate and carry out procedures sequentially, and select and apply strategies to solve problems.

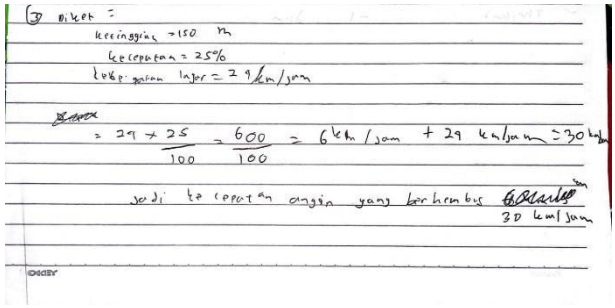

Figure 11. Level 3 student answers

Students' mathematical literacy skills at level 4 are able to work on level 4 correctly, this is in line with the research of Muslimah & Pujiastuti (2020), there are 7 students who are able to solve problem number 4 correctly, where question number 4 is included in the level 4 question category. Students also show good abilities in solving complex problems and applying them to real-life contexts. High-ability students show good mathematical literacy performance, namely students are able to fulfill the three aspects of the mathematical literacy process, namely formulating, applying and interpreting mathematical results into real-life contexts (Farida, Qohar, & Raharjo, 2021). This is also in line with the definition of mathematical literacy according to Ojose (2011) mathematical literacy is the knowledge to know and apply basic mathematics in everyday life.

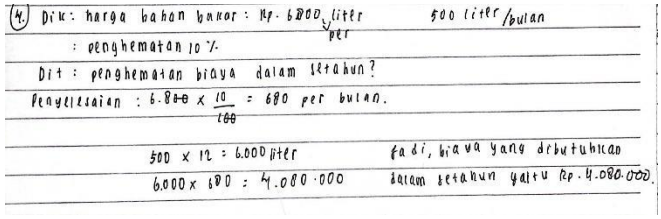

Figure 12. Level 4 student answers

Not a single student was able to reach level 5 and level 6. This occurred because the level reached the highest level. Based on the results of interviews with mathematics teachers, students' ability to solve mathematics problems was still low and students felt the time to work on the questions was short so they could not answer all the questions. When answering questions, students appeared not very focused, which disrupted their concentration while working due to the less conducive situation. This is in line with the results of the 2022 PISA Indonesia which showed that no Indonesian students reached the highest levels, namely levels 5 and level 6 (OECD, 2023).

Conclusion

Based on the presentation of research results and discussion on students' mathematical literacy skills in solving PISA mathematics problems, it was found that the majority of students at SMPN 13 Mataram were at level 1 (34.60%) and level 2 (23.1%). Only a few reached level 3 (13.46%) and level 4 (9.61%), and none reached level 5 and level 6. At level 1, students were able to formulate explicit information, apply simple algorithms, and interpret results into the context of the problem. At level 2, students were able to formulate implicit information, apply simple strategies, and interpret results into the context of the problem. At level 3, students were able to interpret complex explicit information with distractors, apply strategies with sequential decisions, and interpret results into the context of the problem. At level 4, students were able to formulate explicit information related to everyday life, apply strategies for complex concrete situations, and interpret results into the context of the problem. No students reached level 5 and level 6..

Based on this, teachers are expected to develop PISA-standardized questions within real-world contexts. The limited research subjects in a single school mean that the results cannot be

generalized. Furthermore, future researchers can implement appropriate learning models to improve students' mathematical literacy skills and examine the factors influencing them.

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