EDUMATIKA: *Jurnal Riset Pendidikan Matematika* *e-ISSN 2620-8911*
Volume 8, Nomor 2, November 2025 *p-ISSN 2620-8903*

Students' Obstacles and Difficulties in Mathematical Literacy Across Skill Levels and Learning Styles

Irma Amelia[1, a)], Tatang Herman[1], Lukman[1]

[1] *Universitas Pendidikan Indonesia*
229 Dr. Setiabudi Street, Isola, Sukasari, Bandung, West Java, Indonesia 40154

[a)] ameliairma21@upi.edu

Abstract. This study aims to analyze the variations in students' obstacles and difficulties in mathematical literacy across different skill levels and learning styles. Through qualitative research with a phenomenological approach, the subject selected using purposive sampling. This research involved nine students of a junior high school in Bandung, Indonesia, each representing three learning styles (visual, auditory, and kinesthetic) and three levels of mathematical literacy (high, medium, and low). Data were analyzed using data reduction, data presentation, and conclusion drawing. The findings relveal that students' obstacles and difficulties in mathematical literacy varie based on their skill levels and learning styles. Students with moderate and low skills commonly experience difficulties in understanding context, processing information, creating mathematical models, and arguing and evaluating solutions. Differences in learning styles also determine the types of obstacles and difficulties that arise: visual students have difficulty in understanding verbal information, auditory students have difficulty in interpreting symbols and visual representations without verbal explanations, and kinesthetic students need concrete experiences to understand abstract concepts. These findings emphasize the importance of adjusting learning strategies so that all stages of mathematical literacy can develop optimally for all students with varie learning styles.

Keywords: Cognitive Difficulties; Learning Styles; Mathematical Literacy; Student Obstacles

Abstrak. Tujuan penelitian ini adalah untuk menganalisis hambatan dan kesulitan siswa dalam literasi matematika berdasarkan tingkat kemampuan dan gaya belajar. Metode penelitian yang digunakan adalah penelitian kualitatif dengan pendekatan fenomenologis. Teknik pemilihan subjek yaitu *purposive sampling*. Penelitian ini dilakukan di salah satu SMP di kota Bandung. Subjek penelitian terdiri dari sembilan siswa yang mewakili tiga gaya belajar (visual, auditori, dan kinestetik) dan tiga tingkat kemampuan literasi matematika (tinggi, sedang, dan rendah). Teknik analisis data yang digunakan dalam penelitian ini yaitu reduksi data, penyajian data, dan penarikan kesimpulan. Hasil penelitian ini menunjukkan bahwa hambatan literasi matematika siswa bervariasi berdasarkan tingkat kemampuan dan gaya belajar mereka. Siswa dengan kemampuan sedang dan rendah mengalami kesulitan dalam memahami konteks, memproses informasi, membuat model matematika, serta berargumen dan mengevaluasi solusi. Perbedaan gaya belajar juga menentukan jenis hambatan yang muncul: siswa visual kesulitan dalam memahami informasi verbal, siswa auditori kesulitan dalam menafsirkan simbol dan representasi visual tanpa penjelasan verbal, dan siswa kinestetik membutuhkan pengalaman konkret untuk memahami konsep abstrak. Temuan ini menekankan pentingnya menyesuaikan strategi pembelajaran agar semua tahap literasi matematika dapat berkembang secara optimal bagi semua siswa dengan berbagai gaya belajar.

Kata kunci: Gaya Belajar; Hambatan Siswa; Kesulitan Kognitif; Literasi Matematika

Available online at journal homepage:
http://ejournal.iainkerinci.ac.id/index.php/edumatika
Email: edumatika@iainkerinci.ac.id
DOI: https://doi.org/10.32939/ejrpm.v8i2.6144

EDUMATIKA: *Jurnal Riset Pendidikan Matematika* *e-ISSN 2620-8911*
Volume 8, Nomor 2, November 2025 *p-ISSN 2620-8903*

INTRODUCTION

According to the National Council of Teachers of Mathematics (NCTM), mathematical literacy comprises five competencies, namely understanding mathematical concepts, mathematical reasoning, mathematical communication, mathematical connections, and mathematical problem solving (NCTM, 2000). Mathematical literacy is also part of the knowledge and skills of 21st-century students in learning related to mathematical concepts in reasoning, analyzing, and interpreting data in varous form, such as text, symbols, graphics, and numbers, to solve problems in everyday life. According to the Organisation for Economic Co-operation and Development (OECD), mathematical literacy includes mathematical reasoning using mathematical concepts, procedures, facts, and tools to describe, explain, and predict phenomena (OECD, 2018). Thus, the mathematical skills needed to solve real-life problems are mathematical literacy.

Mathematical literacy is crucial for students, as it help them use mathematics in everyday life, use efficient methods for problem solving, evaluate whether the results obtained are reasonable, and analyze situations and draw conclusions (Gench & Erbas, 2019). However, the importance of mathematical literacy has not yet been matched by the quality of education in Indonesia, as reflected in various types of international assessments, particularly the Programme for International Student Assessment (PISA). PISA assesses the literacy skills of 15-year-old students in reading, mathematics, and science. In mathematics, PISA classifies mathematical literacy into six proficiency levels to provide a more detailed description of students ability to use and understand mathematics in everyday and more complex situations (OECD, 2016). The level range from level 1, representing basic skills, to level 6, which requires advanced reasoning and complex problem-solving skills.

Based on the PISA 2022 results, Indonesian students' mathematical literacy skills remain significantly below the international average. Indonesia's mathematics score was recorded at 366, lower than the previous cycle, with the majority of students achieving below the global average (OECD, 2023). Most Indonesian students are only able to reach level 2 of 6 or even below, which shows that students still have difficulty connecting mathematical concepts to real-life contexts and drawing logical conclusions. This national trend is consistent with the findings of Sumarni et al. (2023), who reported that junior high school students also performed poorly on PISA tasks in the uncertainty and data domain. Students had difficulty interpreting information, selecting appropriate strategies, and drawing accurate conclusions. These results further highlight the need to strengthen students' reasoning and contextual understanding to improve mathematical literacy.

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In the learning process, various problems often arise and hinder the optimal achievement of learning objectives. Problems in learning can be seen from the difficulties experienced by students in solving the problems given. Permata et al. (2021) stated that learning difficulties arise due to obstacles originating both externally and internally within students. Learning obstacles, also known as learning obstacles, are conditions in which individuals are unable to follow the learning process properly, characterized by certain obstacles in achieving learning outcomes (Brousseau, 2002). In addition, there are also difficulties experienced by students in mathematics. Mathematical difficulties have certain characteristics, namely difficulties in processing information, difficulties related to language and reading skills, and mathematical anxiety (Lerner & Kline, 2006). Therefore, learning mathematics difficulties can be identified through recurring patterns of mistakes made by students in solving problems.

Previous studies indicate that students' mathematical literacy skills are still low. A study by Damanik & Handayani (2023) showed that students demonstrated inaccuracies in following problem-solving procedures. Similarly, Ningsih et al. (2025) reported that all three indicators of students' mathematical literacy were categored low, reflecting a weak understanding of contextual problems and difficulties in organizing solutions steps. Harisman et al. (2023) also found that junior high school students still experience obstacles in reasoning and applying concepts to context-based literacy questions. Furthermore, Rivai et al. (2023) showed that differences in learning styles also affect students' ability to solve PISA questions, where some learning styles are less effective in processing verbal and complex information. Overall, mathematical literacy is influenced by various factors, one of which is learning style (Madrayati et al., 2019). Therefore, it is important to evaluate mathematical literacy skills based on learning styles in order to determine a more appropriate and effective learning approach for students.

According to De Porter & Hernacki (2015), learning style is a combination of how a person absorbs, organizes, and processes information. Sugihartono et al. (2013) revealed that learning style is a collection of personal characteristics that make learning effective. There are three modalities in learning styles, namely visual, auditory, and kinesthetic. If someone understands and recognizes their own learning style, they will find it easier to adapt effective learning strategies so that the learning process becomes more efficient. This is supported by the results of Suyono (2018) research, which found that learning styles have a significant effect on student learning outcomes. Thus, understanding students' learning styles is important in supporting optimal learning, including the development of mathematical concepts understanding and improving mathematical literacy skills.

Several studies have shown the relationship between mathematical literacy and learning styles. Rismen et al (2022) found that mathematical literacy abilities differ according to learning

EDUMATIKA: *Jurnal Riset Pendidikan Matematika* *e-ISSN 2620-8911*
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styles: visual and auditory students are competent in reproduction, while kinesthetic students are competent in connection. Cahyani et al (2023) showed differences in achievement at level 1 of mathematical literacy, where visual students have high abilities and easily understand pictorial information, auditory students are more receptive to verbal explanations but weak in written representation, and kinesthetic students have difficulty focusing and are unable to complete problems thoroughly. Based on these findings, the novelty of this study lies in in-depth exploration of students' obstacles and difficulties in completing mathematical literacy problems by considering both learning styles, and literacy levels.

Students' obstacles and difficulties in mathematical literacy need to be identified based on their level of mathematical literacy and learning style, as each student has different cognitive abilities and ways of processing information. Each level of literacy requires abilities ranging from understanding basic information to complex reasoning (Kappassova et al., 2025). Therefore, teachers need to know specifically what aspects cause difficulties for students, such as understanding context, modeling problems, choosing strategies, or drawing conclusions. Differences in students' learning styles, such as visual, auditory, or kinesthetic, also affect how they understand questions and solve math problems (Cahyani et al., 2023). If obstacles are not identified based on these two aspects, learning strategies may be inappropriate and students will continue to experience difficulties even after receiving explanations. By identifying obstacles based on level and learning style, teachers can design interventions tailored to needs, adjust learning methods and media, and improve the effectiveness of the learning process. This approach supports meaningful learning planning and improves overall mathematical literacy.

The purpose of this study was to analyze students' obstacles and difficulties based on their mathematical literacy levels and learning styles. The results of this study are expected to contribute to the world of education, particularly mathematics education, which can be used as a reference framework in developing research related to junior high school students' mathematical literacy skills in solving mathematical literacy problems, taking into account students' learning styles.

METHOD

This study employed qualitative research design with a phenomenological approach, aiming to explore students lived experiences related to obstacle and difficulties in mathematical literacy. These approach was chosen to obtain an in-depth understanding of how students with different mathematical literacy levels and learning style experience and interpret matmematical literacy taks. For that aim, this study involved nine eight-grade students in Bandung, Indonesia. Initially, all students in one class participated in the written mathematical literacy test and learning style

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questionnaire. But only nine students were selected purposively to represent three levels of mathematical literacy (high, medium, and low) and three learning styles (visual, auditory, and kinesthetic) for further qualitative analysis and interviews.

The main instrument in this study was written mathematical literacy test designed by the researcher based on the PISA framework. The test consisted of seven items in the form of multiple choice and essay questions, each representing three indicators of mathematical literacy: formulating situations mathematically; applying concepts, facts, procedures, and reasoning; and interpreting and evaluating mathematical results. The test items covered several mathematics topic, including statistics, integers, distance-speed-time, social arithmetic, the Pythagorean theorem, fractions, and spatial figures (see Table 1).

Table 1. Problems of Mathematics Literacy

Number **Problems**

1. Take a look at the following table!

Name	Total Kicks	Successful Kick
Rizky	10	8
Agus	18	15
Fadil	16	10
Ihsan	12	6

The table above shows the scores from penalty kick practice by four futsal players.
Based on the data above, determine whether each of the following statements is true or false by blackening one of the circles!

Statement	Correct	Wrong
Rizky took 10 penalty kicks.	◯	◯
Fadil scored 15 successful shots.	◯	◯
Ihsan scored 6 goals from 12 shots.	◯	◯
Agus scored 15 goals.	◯	◯

2. A team from BASARNAS is searching for victims who drowned while surfing in the middle of the sea. The names of the victims in this incident are Suci, Intan, Andi, Idris, and Epran. The results of the search show the locations of the victims in the following table.

Victim's Name	Victim's Position
Suci	19 meters below sea level
Intan	7 meters above Suci
Andi	3 meters above Intan
Idris	8 meters below Suci
Epran	10 meters above Idris

Based on the above discourse, check (✓) each statement that is true!
- ☐ Suci is at a depth of 19 meters
- ☐ Intan is at a depth of 12 meters.
- ☐ Idris is at a depth of 27 meters.
- ☐ Epran is at a depth of 17 meters.

3. 

Every morning, Lani walks from her house to school at a constant speed of 80 meters per minute. Look at the following picture to find out the distance from Lani's house to school. How long does it take Lani to get to school?

EDUMATIKA: Jurnal Riset Pendidikan Matematika *e-ISSN 2620-8911*
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Number	Problems
4.	 Meli has a younger sibling who will soon turn 5 years old. Her mother asked Meli to help prepare for the birthday party by making a list of birthday supplies to be distributed to the guests. The birthday party was attended by 10 members of Meli's extended family and a number of her younger sibling's friends. There were 5 adults in Meli's extended family. Each child who attended received a birthday hat. If the price of one hat is Rp2,500.00 and the mother has prepared Rp75,000.00 to buy hats, then the maximum number of Meli's friends who can receive hats is… A. 35 B. 52 C. 25 D. 15
5.	 Mrs. Titi made decorative flags for the school party. The decorative flags were right-angled triangles with two sides that differed in length by 3 meters. The shape of the flags can be seen in the following picture. Based on the passage above, if the side that forms the right angle of the flag is extended to twice its length, determine whether each of the following statements is true or false by blackening one of the circles!

Statement	Correct	Wrong
The slanted side of the flag becomes twice as long	○	○
The difference between the sides forming the right angle of the flag is doubled.	○	○
The circumference of the flag doubled.	○	○
The flag's area doubled	○	○

6.	In the regent election in Tanah Laut Regency, there were three candidates: Mr. Yudis, Mr. Bakri, and Mr. Muchlis. The results showed that: Mr. Yudis received 1/3 of the total valid votes, Mr. Bakri received 25% of the total valid votes, and Mr. Muchlis received the rest. It is known that the total number of voters who came to the polling stations was 120,000, and 15% of them cast invalid votes. Determine the number of valid and invalid votes! How many votes did each candidate receive? Based on these results, which candidate received the most votes? Explain with a comparison! If the election system uses two rounds and only the two candidates with the most votes advance, who are those two candidates? Explain mathematically!
7.	 Uno Stacko is a game that combines the fun of Uno with the challenge of building a tower out of blocks. The game involves players taking turns removing blocks from the tower and placing them on top, without causing the tower to collapse. As can be seen in the figure, the arrangement of wooden blocks resembles a prism with a square base. If the volume of the arrangement of wooden blocks is known to be 1,458, one student suggests that the size of each block is 6 cm × 6 cm × 6.75 cm, and another student suggests a size of 9 cm × 9 cm × 1.8 cm. Evaluate both suggestions: do they both produce the correct volume? In your opinion, which size is more suitable for building a stable and tall tower? Explain your reasoning mathematically and logically!

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The validity and reliability of the test were examined, and the results indicated that all items had high to very high validity, whith an overall reliability coefficient indicating high reliability (seeTable 2).

Table 2. Validity and Reliability Results

Question Number	Each Items Validity		Reliability
	Value	Interpretation	
1	0,71	High	0,82 (High)
2	0,82	High	
3	0,70	High	
4	0,93	Very High	
5	0,87	High	
6	0,74	High	
7	0,90	Very High	

In this study, the researcher categorized students' mathematical literacy levels only up to level 5, because level 6 requires more complex problem design, open-ended, and requires much more time to complete, which is not in line with the time constraints and scope of the study. The descriptions of each level based on OECD (2019) are shown in Table 3.

Table 3. Levels of Mathematical Literacy According to PISA

Level	Mathematical Literacy Levels According to PISA
Level 1	Students can use their knowledge to solve routine problems and can solve problems in general contexts.
Level 2	Students can interpret problems, solve them using formulas, carry out simple procedures, and provide direct explanations.
Level 3	Students can perform procedures well in solving problems and can choose simple problem-solving strategies and communicate their interpretations of the results.
Level 4	Students can work effectively with models and can select and interpret different representations, then connect them to the real world. Students can provide explanations and communicate them with arguments based on their interpretations and actions.
Level 5	Students can work with models for complex situations, make assumptions, select, compare, and evaluate strategies to solve problems related to the model. Students can reflect on what they have done and communicate it.
Level 6	Students can use their reasoning to solve mathematical problems, make generalizations, formulate, communicate, interpret, and argue about a problem in its original context.

Criteria for categorizing students into high, medium, and low literacy levels were determined based on the highest level achieved, the number of correct answers, and the distribution of correct responses across levels (see Table 4).

Table 4. Criteria for Students' Mathematical Literacy Levels

Category	Criteria
High	• Students are able to answer correctly up to level 5 • Students answer 6-7 questions correctly • Only one incorrect answer is allowed at any level
Medium	• Students are able to answer correctly up to level 3 or 4 • Students answer 5-6 questions correctly • Correct answers must be spread across two/three levels
Low	• Students are able to answer correctly up to level 1 or 2 • Students answer 0-4 questions correctly • Correct answers must be spread across one or two levels

Students' learning style were identified through a questionnaire, consisting 13 statements representing visual, auditory, and kinesthetic modalities, adapted from Nursafitri (2022). The

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questionnaire was given to a class of 28 students. To deepen the analysis, unstructured interviews were conducted with nine selected students focused on the thinking process, obstacles, problem-solving strategies, and the influence of learning styles on how to understand, analyze, and evaluate information. Documentation was used as complementary data.

The data analysis technique in this study uses the data analysis procedures recommended by Miles et al. (2014), namely data reduction, data presentation, and conclusion drawing. To ensure data validity, this study uses the examination techniques proposed by Sugiyono (2019), which include testing credibility, transferability, dependability, and confirmability, supported by data triangulation from tests, questionnaires, and interviews.

RESULTS AND DISCUSSION

The results of the test show that of the total 28 students, 5 students were in high category, 6 students were in medium category, and 17 students were in low category. Meanwhile, the results of the learning style questionnaire show that 12 students have a visual learning style, 9 students have an auditory learning style, 4 students have a kinesthetic learning style, and 3 students have a mixture learning style (see Table 5).

Table 5. Students' Test Results, Mathematical Literacy Levels, and Learning Styles

Students	Mathematical Literacy and Problems							Category of Studnets' Mathematical Literacy Skills	Learning Style Score			Category of Studnets' Learning Style
	L.1		L.2		L.3	L.4	L.5					
	P.1	P.2	P.3	P.4	P.5	P.6	P.7		Vis.	Aud.	Kin.	
Student 1	✓	✓	✓	✓	×	×	×	Low	1	9	3	Auditory
Student 2	✓	✓	✓	✓	×	×	×	Low	2	6	5	Auditory
Student 3	✓	✓	✓	✓	✓	✓	✓	High	3	3	7	Kinesthetic
Student 4	✓	✓	✓	✓	×	×	×	Low	3	4	6	Kinesthetic
Student 5	✓	✓	✓	×	×	×	×	Low	6	4	3	Visual
Student 6	✓	✓	✓	✓	×	×	✓	High	3	6	4	Auditory
Student 7	✓	✓	✓	✓	×	×	×	Low	6	4	3	Visual
Student 8	✓	✓	✓	✓	×	×	×	Low	4	7	2	Auditory
Student 9	✓	✓	✓	✓	×	✓	×	Medium	6	3	4	Visual
Student 10	✓	✓	✓	✓	✓	×	×	Medium	7	3	3	Visual
Student 11	✓	✓	✓	✓	×	×	×	Low	7	2	4	Visual
Student 12	×	×	✓	✓	×	×	×	Low	6	8	4	Auditory
Student 13	✓	✓	✓	✓	×	×	×	Low	6	5	2	Visual
Student 14	✓	✓	✓	✓	×	✓	×	Medium	2	6	5	Auditory
Student 15	✓	✓	✓	✓	×	×	×	Low	1	5	7	Kinesthetic
Student 16	×	✓	✓	✓	×	×	×	Low	5	3	5	Mixture
Student 17	✓	✓	✓	✓	✓	×	×	Medium	5	6	2	Auditory
Student 18	✓	✓	✓	✓	×	✓	✓	High	5	6	2	Auditory
Student 19	✓	×	✓	×	×	×	×	Low	7	3	3	Visual
Student 20	✓	✓	✓	✓	×	✓	×	Medium	2	5	6	Kinesthetic

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Students	Mathematical Literacy and Problems							Category of Studnets' Mathematical Literacy Skills	Learning Style Score			Category of Studnets' Learning Style
	L.1		L.2		L.3	L.4	L.5					
	P.1	P.2	P.3	P.4	P.5	P.6	P.7		Vis.	Aud.	Kin.	
Student 21	✓	✓	✓	✓	×	×	×	Low	1	7	5	Auditory
Student 22	×	✓	✓	✓	×	×	×	Low	5	4	4	Visual
Student 23	✓	✓	✓	✓	×	✓	✓	High	7	3	3	Visual
Student 24	✓	✓	✓	✓	×	×	×	Low	5	4	4	Visual
Student 25	✓	✓	✓	✓	×	×	×	Low	3	5	5	Mixture
Student 26	✓	✓	✓	✓	✓	✓	✓	High	1	6	6	Mixture
Student 27	✓	✓	✓	✓	✓	×	×	Medium	7	5	1	Visual
Student 28	✓	✓	✓	✓	×	×	×	Low	7	5	1	Visual

Note: L = Level, P = Problem, Vis. = visual, Aud. = auditory, Kin. = Kinesthetic

Based on the test scores and questionnaire results, the researcher select nine students as research subjects (see Table 6).

Table 1. Selected Research Subjects

Subject	Label	Level of Mathematical Literacy Skills	Learning Style	Selected Student Code
1	SV1	High	Visual	Student 23
2	SV2	Medium	Visual	Student 27
3	SV3	Low	Visual	Student 24
4	SA1	High	Auditory	Student 6
5	SA2	Medium	Auditory	Student 14
6	SA3	Low	Auditory	Student 8
7	SK1	High	Kinesthetic	Student 3
8	SK2	Medium	Kinesthetic	Student 20
9	SK3	Low	Kinesthetic	Student 15

Obstacles & Difficulties at Proficiency Level 1

The first obstacle in level 1 relates to understanding the context of the question, where some students being confused by the use of certain terms. Such as SV1 stated that in problem 1, the use of the words "close" or 'far' from sea level would be clearer. Meanwhile, SK2 also was confused by the phrase "above Suci" in problem 2, so that he could not immediately determine the position referred to. In addition, students also had difficulty interpreting the information in the table. SV1 did not fully understand the relationship between the data in the table and the question in problem 2.

> *"Perhaps the choice of words to describe the position of the victim would be clearer if the words close or far from sea level were used. ... I also had a little difficulty understanding the relationship between the table and the question." (SV1)*

Meanwhile, SA3 was not careful enough when reading the table for problem 1 and was often unsure which data was appropriate because he only glanced at it. Another difficulty arose in understanding basic concepts related to the use of positive and negative signs. SK3 expressed

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confusion in determining the correct sign for problem 2. SV2 in problem 2 also was unsure whether "above the surface" was positive or negative.

"Sometimes I only read the table briefly, so I'm not sure which data is appropriate for the question." (SA3)

"I am confused about using positive or negative signs in the question." (SK3)

"In the question, I am confused whether above the surface is negative or positive." (SV2)

The next obstacle occurred in understanding the problem, where SV3 in problem 2 thought that the answer was directly in the table without the need for further calculation. Meanwhile, SA2 in problem 1 was not focused when reading the instructions and did not understand correctly what was asked in the question.

"I thought the answer was in the table, but it turned out that I had to calculate it first." (SV3)

"I was not focused when reading the question instructions." (SA2)

Overall, these findings was summarized in Table 7.

Table 7. Summary of Students Obstacles and Difficulties in Level 1

Level 1 – Problems 1 & 2	
Aspects	**Description**
Subjects	SV1, SK2, SV1, SA3, SK3, SV2, SV3, SA2
General conclusion	Students still have difficulty understanding simple contexts, reading tables, using signs (+/–), and accurately understanding instructions.
Obstacles & Difficulties	• Confusion with terms (e.g., "close/far," "above Sacred"). • Difficulty reading data relationships in tables. • Lack of thoroughness in reading data. • Confusion with the use of positive/negative signs. • Assuming that answers can be found directly in the table without further processing. • Lack of focus in understanding instructions.

Obstacles and Difficulties at Proficiency Level 2

The first difficulty in level 2 was related to obstacles in understanding the context of the question. SK3 stated that problem 4 was too long, which made it difficult to determine the number of children in Meli's family. The next difficulty arises at the stage of modeling the problem, where SA3 in problem 4 was often confused about determining important and unimportant information, making it difficult to form an appropriate model.

"Problem 4 is too long, so I am confused about the number of children in Meli's family." (SK3)

"I am often confused about determining which information is important and which is unnecessary, so it is difficult to make a model." (SA3)

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Meanwhile, SV3 also had difficulty understanding the question in problem 4, so the model was not in accordance with the question. In addition, several students also had difficulty choosing the right solution strategy. In problem 4, SV2 needed a long time because unsure strategy to use.

"I had difficulty understanding the question, so the model I made was often not in accordance with the question." (SV3)

"I like to think for a long time because I'm not sure which strategy is suitable for the question." (SV2)

Meanwhile, SV3 on problem 4 felt confused when doing the subtraction in the question. The final difficulty arose in the ability to apply formulas correctly; SA3 in problem 3 often used manual methods because he did not memorize the formulas. Meanwhile, SA2 also had somewhat forgotten the formula for calculating time.

"Because I was confused about the subtraction of the number of children's hats, it took me a long time to do it." (SV3)

"I more often use manual methods because I never memorize the formulas." (SA3)

"I have somewhat forgotten the formula for calculating time, miss." (SA2)

Overall, these findings was summarized in Table 8.

Table 8. Summary of Students Obstacles and Difficulties in Level 2

Level 2 – Problems 3 & 4	
Aspects	**Description**
Students with obstacles	SK3, SA3, SV3, SV2, SV3, SA3, SA2
General conclusion	Difficulties arise in reading long contexts, selecting important information, creating simple models, choosing strategies, and remembering basic formulas.
Obstacles & Difficulties	• Long questions cause confusion in understanding the context. • Difficulty determining important information to create a model. • Unclear or hesitant problem-solving strategies. • Difficulty with basic calculations such as subtraction. • Not memorizing time formulas and more often using manual methods.

Obstacles and Difficulties at Competency Level 3

At level 3, several obstacles and difficulties were found that affected the process of solving mathematical literacy problems. SK2 had difficulty understanding the context of the problem, especially when interpreting statements such as "the sides are doubled in length". SK2 also had difficulty identifying the problem and therefore did not know what was actually being asked. Meanwhile, SV3 also expressed similar confusion when reading problem 5.

"I don't understand what it means to double the length of the sides. Does that mean all sides become longer? ... I didn't understand question number 5, so I didn't know what was being asked." (SK2)

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"I'm confused, miss. I don't know what to do." (SV3)

Even though SA2 knew the lengths of sides a, b, and c, there is difficulty in determining how to answer the question according to the requirements. SV1 also made a mistake in applying the formula, made a mistake in his calculations, and resulting in an incorrect final answer. Finally, SA1 had difficulty in drawing conclusions because unsure whether the answer was correct or in accordance with the context of the question.

"I know the lengths of a, b, and c, but I'm confused about how to answer the question." (SA2)

"I made a mistake in my calculations, miss, so my answer was wrong." (SV1)

"I already have the answer, but I don't know if it's right or wrong." (SA1)

Overall, these findings was summarized in Table 9.

Table 9. Summary of Students Obstacles and Difficulties in Level 3

Level 3 – Problem 5	
Aspects	**Description**
Students with obstacles	SK2, SV3, SA2, SV1, SA1
General conclusion	Students have difficulty understanding mathematical statements, identifying problems, choosing strategies, applying formulas, and drawing correct conclusions.
Obstacles & Difficulties	• Confused about the meaning of the phrase "twice as long." • Don't understand what the question is actually asking. • Don't know what steps or strategies to use. • Made a miscalculation, resulting in the wrong answer. • Unsure of my own answers and conclusions.

Obstacles and Difficulties at Proficiency Level 4

The first obstacle in this level was related to understanding the context of the question, where SK3 did not understand the meaning of the terms "valid vote" and "invalid vote," making it difficult to determine the appropriate solution steps. The next difficulty arose in connecting mathematical representations, such as SA3 only counted Bakri's votes by subtracting them from 102,000, then immediately converted the result to a percentage without understanding the relationship between the data in the question.

"Miss, I don't understand what valid votes and invalid votes mean." (SK3)

"I'm confused, miss. I just calculated Bakri's votes from 102,000 minus Muchlis' votes, then I converted it to a percentage." (SA3)

In addition, some students had difficulty adjusting the mathematical model to the given context. For instance, SA1 confused about the correct process because calculated 25% of 100,000 to be 50,000 and then added 4,000 to make it equal to 102,000.

"I calculated 25% of 100,000 to be 50,000, then I added 4,000 to make it equal to 102,000. So I'm a little confused about how to do it, miss." (SA1)

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There were also obstacles in providing appropriate mathematical reasoning, as shown by SV1 and SA2, who stated that the candidates who advanced to the second round were Yudis and Muchlis "because they had many votes," without providing supporting mathematical explanations. In addition, some students had difficulty organizing large amounts of complex information. SV3 being confused where to start calculating because there was too much data.

"Yudis and Muchlis advanced to the second round because they had many votes." (SV1)

"Anyway, it's Yudis and Muchlis, because they got the most votes." (SA2)

"I'm confused, miss, because there's so much data. I don't know where to start calculating." (SV3)

Meanwhile, SK3, also stated that the mixed information made it difficult to work on the question systematically.

"The information is mixed up, so it's difficult to work on." (SK3)

Overall, these findings was summarized in Table 10.

Table 10. Summary of Students Obstacles and Difficulties in Level 4

Level 4 – Problem 6	
Aspects	**Description**
Students with obstacles	SK3, SA3, SA1, SV1, SA2, SV3, SK3
General conclusion	The main difficulties are understanding terms in real contexts, connecting mathematical representations, adjusting models, and explaining mathematical reasoning.
Obstacles & Difficulties	• Not understanding terms such as "valid/invalid votes." • Calculating without understanding the relevance of the data. • Applying models that are not appropriate to the context (e.g., manipulating numbers to make them fit). • Reasons not supported by mathematical arguments ("because there were many votes"). • Confusion due to the large amount of mixed data.

Obstacles and Difficulties at Proficiency Level 5

The first obstacle arose in understanding the context of the question, SK3 being confused where to start because the question was too long and contained several pieces of information, such as the total volume and two block sizes. While, SA3 experienced a similar difficulty, not understanding the meaning of the phrase "stable and tall tower."

"I'm confused, miss. The question is really long, there's total volume and two block sizes, I don't know where to start." (SK3)

"I don't understand what 'stable and tall tower' means, so it's hard to imagine which block to choose." (SA3)

SV3 also did not know what a square-based prism was, making it difficult for him to imagine how to solve the problem. In addition, students also had difficulty analyzing and

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interpreting complex information, as expressed by SV3, who was confused about choosing relevant information because the question contained the initial volume and two proposed block sizes.

"I don't know what a square-based prism means, miss. So, I'm confused about how to calculate the volume." (SV3)

"I was confused. There was the initial volume, then there were two proposed block sizes. I didn't understand which information to use first, so I only looked at some of it." (SV3)

When providing mathematical and logical reasoning, some students were unable to explain their answers with appropriate mathematical arguments. For example, SV3 chose the second proposal simply because it seemed more reasonable without rechecking the calculations (see Figure 1).

"I thought the volumes were different, so I chose the second proposal because it made more sense, but I didn't check it again." (SV3)

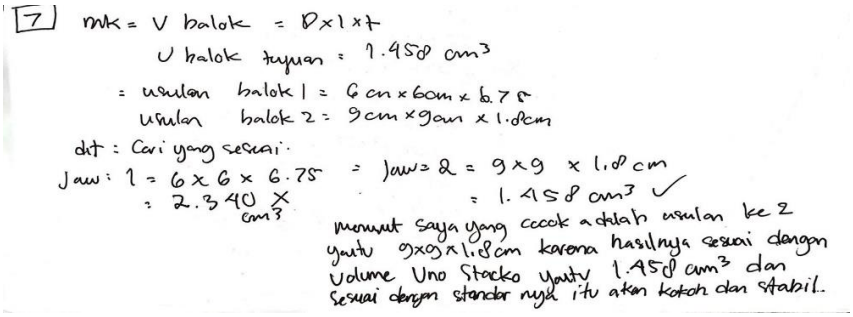

Figure 1. SV3's Answer

Meanwhile, SK2 chose the first proposal because it had a larger volume, which he believed would make it more sturdy, without considering the context of mathematical stability (see Figure 2).

"I chose proposal 1 because it had a larger volume, so I thought it would be more solid and heavier (SK2)

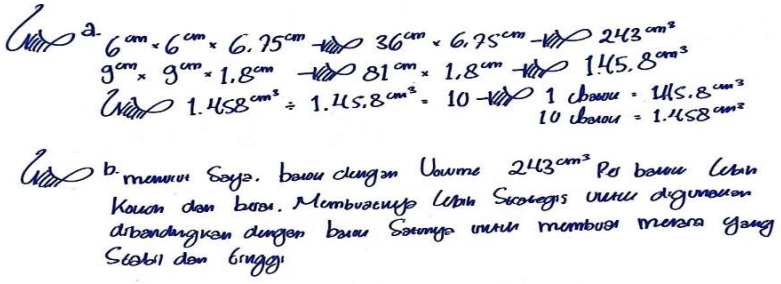

Figure 2. SK2's Answer

The next difficulty arises in integrating representation and reasoning, as experienced by SA3, who was only able to calculate the volume but could not relate the result to the context of

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a stable tower (see Figure 3-left). SA2 obtained two calculation results but remained confused about how to relate them to the conditions for a stable and tall structure (see Figure 3-right).

"I can only calculate the volume, miss, but I'm confused about comparing it, so I stopped there." (SA3)

"I've calculated the volume. Proposal 1 gives a result of 243 cm³, and proposal 2 gives a result of 145.8 cm³. But I'm confused. How does this relate to a stable and tall tower?" (SA2)

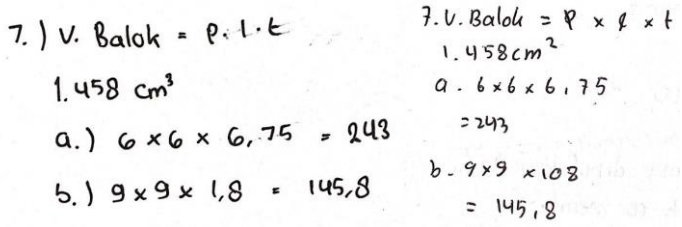

Figure 3. Left: SA3's Answer, Right: SA2's Answer

When evaluating alternative solutions, some students were only able to mention or count the available alternatives without being able to compare them or determine the best choice. For example, SV1 stated that both proposals could be used but did not know how to determine which one was more appropriate (see Figure 4).

"I think both can be used, miss. I'm confused about how to determine which one is more suitable." (SV1)

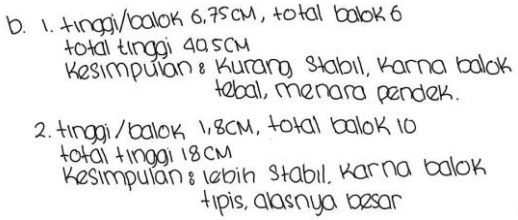

Figure 4. SV1's Answer

Overall, these findings was summarized in Table 11.

Table 11. Summary of Students Obstacles and Difficulties in Level 5

Level 5 – Problem 7	
Aspects	**Description**
Students with obstacles	SK3, SA3, SV3, SV3, SV3, SK2, SA3, SA2, SV1
General conclusion	The difficulty lies in understanding long and complex contexts, selecting relevant information, providing mathematical reasoning, connecting results to context, and evaluating alternative solutions.
Obstacles & Difficulties	• Confused because the question is very long and contains a lot of information (total volume, block size, etc.). • Does not understand terms such as "stable and tall tower" or "square-based prism." • Difficulty selecting relevant information. • Weak mathematical reasoning (choosing a suggestion because it "makes sense"). • Unable to connect the calculation results to the context of the problem. • Unable to compare alternative solutions or determine the best choice.

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The Obstacles and Difficulties of Students with Visual Learning Style

Students with visual learning styles, namely SV1, SV2, and SV3, experienced difficulties when problems are presented in long texts without visual support such as pictures, tables, or diagrams. These students find it easier to understand information that is visualized concretely, while verbal information often causes them to lose focus on the core of the problem. This obstacle is apparent in the formulation stage, where visual students sometimes fail to accurately identify the relationships between data presented verbally. This condition shows that students with visual learning styles need visual representations to form mathematical models accurately, as explained by Fleming & Mills that visual students process information through observation and are more effective when the material is presented in the form of pictures, graphs, diagrams, or symbols (Nasrul et al., 2025).

The results of this study are reinforced by the findings of Rizki et al. (2023), which show that students with visual learning styles tend to give short answers and have difficulty choosing words when faced with text-based questions. Research by Sari & Rahayu (2021) also states that male students with visual learning styles in the context of quantitative content have not been able to pass the formulation and tool use stages. In line with this, Nayazik's (2022) research found that visual students experience obstacles in numeracy literacy, especially when questions are presented in descriptive form without visual illustrations. Furthermore, research by Rivai et al. (2023) shows that visual students tend to have lower mathematical literacy performance when solving PISA questions that are text-based, complex, and require verbal interpretation skills, even though they perform better on questions with graphical representations or diagrams.

In general, this study found that visual students experience difficulties in mathematical literacy when faced with questions that require the ability to read, understand, and interpret verbal information in depth without visual aids. Visual students tend to be slower in understanding the context of a problem because they do not receive visual stimuli that help them organize information. This condition results in their low ability to construct mathematical representations that are appropriate to the context of the problem, even though they actually have strong potential in understanding concepts through visual representations.

The Obstacles and Difficulties of Students with Auditory Learning Style

Students with auditory learning styles, namely SA1, SA2, and SA3, experienced obstacles and difficulties when learning or solving problems without verbal explanations. They were quicker to understand the context of a problem when listening to the teacher read the problem or explain it directly. This is in line with Fleming and Mills, who state that auditory students find it easier

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to understand and remember concepts when information is conveyed orally through discussions, verbal instructions, or conversations (Nasrul et al., 2025). At the formulating stage, auditory students often needed verbal repetition of information to ensure understanding. Meanwhile, at the interpreting stage, they tend to be able to explain the results in words, but are less thorough in writing down the calculation steps. Auditory students find it easier to understand concepts through verbal explanations and activities that involve listening. This is in line with the opinion De Porter & Hernacki (2015) that auditory students are more optimal when learning through discussion, listening to the teacher's explanations, or repeating information verbally.

The results of this study align with the findings of Sakinah & Avip (2021), who revealed that students with an auditory learning style tend to have low skills in formulating mathematical problems, resulting in frequent errors in the use of basic concepts. This is reinforced by the findings of Sulisawati et al. (2019), who showed that students with an auditory learning style have specific characteristics in understanding questions, such as difficulty recording complete information and being less able to mark important parts of the problem. Furthermore, research by Luqman et al. (2025) emphasized that an auditory learning style is associated with limitations in understanding and solving certain types of problems, so students with these characteristics require more appropriate learning strategies. Overall, these three studies indicate that students with an auditory learning style face obstacles in the process of solving mathematical problems, from the stages of understanding, formulating, to solving problems, which are generally caused by difficulties in capturing and organizing information effectively.

In general, auditory students rely on their hearing ability as the primary channel for processing information. They learn more effectively through direct explanations from teachers, group discussions, dialogues, or learning that involves rhythm and sound. Students with auditory characteristics are less than optimal when faced with material that requires careful reading, independent note-taking, or processing of text-heavy information (Fitriyani & Pradipta, 2025). Without adequate verbal explanation, auditory students tend to lose context, overlook important details, or have difficulty organizing information systematically.

The Obstacles and Difficulties of Students with Kinesthetic Learning Style

Kinesthetic students (SK1, SK2, SK3) experienced obstacles when learning is abstract and does not involve physical activity or direct experience. They find it easier to understand concepts through practice, experimentation, or concrete activities. At the formulating stage, kinesthetic students often need tools or real examples to understand the relationship between variables, while at the employing stage they tend to rush through calculations because they focus more on the results of the practice than on the accuracy of the process. These findings are in line with De

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Porter & Hernacki (2015) who state that kinesthetic students learn most effectively through direct experience and physical activities. Obstacles arise when learning does not provide opportunities to move, interact, or try steps concretely.

The results of this study are supported by Nadila & Lestiana (2024), who found that students with a kinesthetic learning style struggled more than other students, particularly in the indicators of formulating, applying, and interpreting within mathematical literacy. In addition, research by Handoko & Mubarikah (2025) shows that kinesthetic students tend to excel in dealing with contextual questions involving physical activities or direct experiences, but remain weak in understanding visual representations and formal mathematical reasoning. In line with this, research by Ayuningtyas & Nurafni (2025) revealed that learning style has a significant influence on students' mathematical literacy abilities, especially in the concept of unit measurement; kinesthetic students need concrete and manipulative activities to understand concepts, so they are less than optimal when it comes to interpreting abstract or symbolic information. Research by Chairuddin at al. (2025) further reinforces these findings by showing that students' mathematical literacy abilities differ based on their learning styles. They found that students with kinesthetic learning styles tend to perform less well on mathematical literacy tasks that require abstract representation, higher-level reasoning, and interpretation of mathematical symbols.

CONCLUSION

Students with high abilities tended to be able to complete all stages of mathematical literacy well, while students with medium and low abilities experienced more obstacles in understanding context, processing information, creating mathematical models, and providing reasons and evaluating solutions. In addition, visual students tend to have difficulties when information is presented verbally, auditory students have difficulty reading visual and symbolic representations without verbal explanations, while kinesthetic students need concrete experiences to understand abstract concepts. This study considered in determining the most effective learning approach according to students' needs, particularly in accommodating their diverse learning styles. This study also open up opportunities for further studies related to mathematical literacy, including in-depth exploration of students' skills, the difficulties they experience, and the influence of learning styles on their ability to solve mathematical literacy problems.

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