

Analysis of Students' Errors in Solving PISA Mathematical Literacy Problems Based on Wonosobo Ethnomathematics

Aufaa Ronaa Almaas^{1*}, Nuriana Rachmani Dewi², Walid³, Zaenuri⁴

^{1*, 2, 3, 4} Universitas Negeri Semarang, Indonesia

aufaaronaa@students.unnes.ac.id^{1*}

**Corresponding author*

Submitted: 29 May 2026; Revised: 30 June 2026; Accepted: 17 July 2026

ABSTRACT

This study aims to describe students' errors in solving PISA mathematical literacy problems based on Wonosobo ethnomathematics and to identify the types of student errors in the formulate, employ, and interpret indicators. The study used a qualitative descriptive approach with 24 students of class VII B as research subjects. Data collection techniques were carried out through a mathematical literacy test based on the Wonosobo ethnomathematics context, interviews, and documentation of student work results. Data analysis used the Miles, Huberman, and Saldana model which includes data reduction, data presentation, and conclusion drawing. The results showed that students' mathematical literacy abilities were still in the low category with an average score of 52.77. In the formulate indicator, students had errors in systematically constructing mathematical models from contextual problems. In the employ indicator, students were not yet able to use mathematical concepts and procedures appropriately and tended to immediately write the final answer without showing the complete solution steps. Meanwhile, in the interpret indicator, students still had errors in interpreting the solution results according to the context of the problem. The most dominant error occurred in the employ indicator because students were less careful in performing calculations and were not yet accustomed to writing down the solution procedure sequentially. Based on the research results, more contextual and meaningful mathematics learning is needed through an ethnomathematics approach so that students become accustomed to solving problems systematically at the formulate, employ, and interpret stages.

Keywords: *ethnomathematics Wonosobo, mathematical literacy, PISA, student errors.*

Analisis Kesalahan Siswa Dalam Menyelesaikan Soal Literasi Matematika PISA Berbasis Etnomatematika Wonosobo

ABSTRAK

Penelitian ini bertujuan untuk mendeskripsikan kesulitan siswa dalam menyelesaikan soal literasi matematika PISA berbasis etnomatematika Wonosobo serta mengidentifikasi bentuk kesalahan siswa pada indikator formulate, employ, dan interpret. Penelitian menggunakan pendekatan deskriptif kualitatif dengan subjek penelitian siswa kelas VII B yang berjumlah 24 siswa. Teknik pengumpulan data dilakukan melalui tes literasi matematika berbasis konteks etnomatematika Wonosobo, wawancara, dan dokumentasi hasil pekerjaan siswa. Analisis data menggunakan model Miles, Huberman, dan Saldana yang meliputi reduksi data, penyajian data, dan penarikan kesimpulan. Hasil penelitian

menunjukkan bahwa kemampuan literasi matematika siswa masih berada pada kategori rendah dengan nilai rata-rata sebesar 52,77. Pada indikator formulate, siswa mengalami kesulitan dalam menyusun model matematika secara sistematis dari masalah kontekstual. Pada indikator employ, siswa belum mampu menggunakan konsep dan prosedur matematika secara tepat serta cenderung langsung menuliskan jawaban akhir tanpa menunjukkan langkah penyelesaian secara lengkap. Sementara itu, pada indikator interpret, siswa masih mengalami kesulitan dalam menafsirkan hasil penyelesaian sesuai konteks soal. Kesalahan yang paling dominan terjadi pada indikator employ karena siswa kurang teliti dalam melakukan perhitungan dan belum terbiasa menuliskan prosedur penyelesaian secara runtut. Berdasarkan hasil penelitian, diperlukan pembelajaran matematika yang lebih kontekstual dan bermakna melalui pendekatan etnomatematika agar siswa terbiasa menyelesaikan masalah secara sistematis pada tahapan formulate, employ, dan interpret.

Kata Kunci: literasi matematika, PISA, etnomatematika Wonosobo, kesulitan siswa.

How to cite: Almaas, A. R., Dewi, N. R., Walid, Zaenuri. (2026). Analysis of Students' Errors in Solving PISA Mathematical Literacy Problems Based on Wonosobo Ethnomathematics. *Jurnal Riset Pendidikan dan Inovasi Pembelajaran Matematika (JRPIPM)*, 10(2), 188-203. <https://doi.org/10.26740/jrpiPM.v10n2.p188-203>

License



This work is licensed under a [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/).

1. Introduction

Mathematical literacy is one of the essential competencies' students must possess to face the challenges of the 21st century. Mathematical literacy relates not only to the ability to perform mathematical calculations, but also to the ability to understand, use, and interpret mathematical concepts in various real-life contexts (Hayati & Jannah, 2024). This is in line with the Programme for International Student Assessment (PISA) framework, which emphasizes that mathematical literacy is an individual's ability to use mathematics to make acceptable decisions as a wise and productive citizen (OECD, 2023). Given the rapid social changes in the 21st century, globalization, and technological advances that demand higher-order thinking skills, the importance of mathematical literacy has become increasingly clear.

Mathematical literacy is also an essential part of 21st-century ability, which includes critical thinking, creativity, communication, and collaboration. Students' ability to use their knowledge and skills to evaluate, reason, communicate effectively, solve, and interpret problems in various contexts is known as mathematical literacy (Widianti & Hidayati, 2021). Ojose (in Hayati & Jannah, 2024) states mathematical literacy is the ability to understand and apply mathematics in everyday life. The National Council of Teachers of Mathematics (NCTM) emphasizes that mathematics learning must develop problem-solving, reasoning, communication, and mathematical connection skills (Awaji et al., 2025). Accordingly, the current learning paradigm in Indonesia, based on deep learning, requires students not only to understand concepts procedurally but also to apply them meaningfully in real life.

However, in reality, students' mathematical literacy skills in Indonesia are still relatively low. The 2022 PISA results showed that Indonesia's math score was 366, still below the OECD average of 472 (OECD, 2023). In addition, most Indonesian students are still at the minimum competency level, which shows that students have errors in understanding the context of the problem, formulating the problem into a mathematical model (formulate), using mathematical concepts and procedures (employ), and interpreting the results of the solution (interpret) (Yanto

[& Rahaju, 2024](#)). This situation indicates that students are not yet accustomed to facing problems that require reasoning and problem-solving in real-life contexts.

In school, mathematics instruction tends to focus on procedures and the application of formulas, making students less accustomed to solving contextual problems that require higher-order thinking skills ([Fitria et al., 2025](#)). Learning does not provide students with the opportunity to explore contextual problems results in students experiencing misunderstandings about the meaning and application of mathematical concepts in everyday life. Based on daily assessments, end-of-semester exams, and in-class practice exercises, it was found that students still experience difficulties in solving mathematical literacy problems. In daily practice exercises, students still lack a grasp of contextual problems, which must be translated into mathematical concepts. Students tend to have difficulty in understanding information in story problems, determining the correct mathematical model, and interpreting the results accurately, resulting in errors in answering mathematical literacy questions. Furthermore, students often perceive mathematical literacy problems, such as the PISA exams, as complex and difficult to understand because they contain lengthy contexts and require in-depth reasoning. This condition is in line with Selan's research which states that students still experience difficulties in changing contextual problems into mathematical models and interpreting the results into real-world contexts ([Selan et al., 2020](#)).

Furthermore, mathematics learning in the classroom does not fully connect mathematical concepts to the local cultural context that is close to students' lives ([Ramadhani et al., 2023](#)). Yet, the relationship between culture and mathematics can help students understand concepts in a concrete and meaningful way. In line with research ([Jahra et al., 2024](#)), Students' difficulties in mathematical literacy are often caused by a lack of contextual and meaningful learning experiences. Research ([Anjarrani & Kurniasih, 2023](#)) states that students with low literacy skills have errors in using concepts, facts, procedures and reasoning so they cannot solve problems well. Research Goos also shows that using contexts relevant to students' lives can improve mathematical literacy skills because students more easily understand and relate mathematical concepts to real-life experiences ([Goos et al., 2014](#)).

Although various studies have examined mathematical literacy and ethnomathematics separately and within mathematics learning, research specifically analyzing student errors in solving PISA mathematical literacy problems developed based on local ethnomathematics contexts remains limited ([Lestari & Wulantina, 2024](#)). Most previous research has focused on measuring students' mathematical literacy levels, developing ethnomathematics-based teaching materials, or implementing specific learning models to improve mathematical literacy skills ([Pratama & Yelken, 2024](#)). Furthermore, studies that identify in detail the types of student errors in each mathematical literacy process—formulating, employing, and interpreting—in a local cultural context are still scarce ([Munthahana et al., 2023](#)).

Based on these conditions, this study offers novelty by integrating the Wonosobo ethnomathematics context as the basis for developing PISA mathematical literacy questions while simultaneously analyzing student errors at each stage of the mathematical literacy process according to the PISA framework. Unlike previous studies that focused more on measuring the ability or effectiveness of a learning approach ([Pratama & Yelken, 2024](#)), this study focuses on identifying the characteristics of student errors in depth within the local cultural context of Wonosobo. The results are expected to provide a more comprehensive picture of student error patterns, thus providing a basis for designing mathematics learning that is more contextual, relevant to the local culture, and capable of improving students' mathematical literacy skills.

Based on these conditions, it can be concluded that there is a gap between actual conditions in the field and the demands of mathematical literacy skills. Students are not yet accustomed to solving context-based problems, their mathematical literacy skills are still low, and cultural

integration in mathematics learning is not optimal. Therefore, an in-depth analysis of students' difficulties in solving mathematical literacy problems is needed, particularly at each stage of the mathematical literacy process: formulate, employ, and interpret.

Contextual mathematics learning can be realized through an ethnomathematics approach. Ethnomathematics is the study of the relationship between mathematics and culture, specifically how mathematical concepts, practices, and activities develop and are used in the lives of specific communities ([D'Ambrosio, 2016](#)). Ethnomathematics is also understood as a way to learn mathematics through a local cultural context so that learning becomes more meaningful and relevant for students ([Rosa & Orey, 2016](#)). Thus, ethnomathematics integrates local culture into mathematics learning so that students can understand mathematical concepts through experiences close to their lives. This is in line with Hasanah's research which shows that ethnomathematics-based learning is effective in improving students' mathematical literacy because it connects mathematical concepts with real situations and local culture ([Hasanah et al., 2024](#)).

In this study, Wonosobo ethnomathematics, such as the bundengan culture, weaving patterns, and local community activities, served as the context for developing PISA-based mathematical literacy questions. The use of this local context is expected to help students understand problems, relate mathematical concepts to everyday life, and enhance the meaningfulness of learning. This aligns with Rosa and Orey opinion, which states that ethnomathematics can bridge mathematical concepts with students' culture and real-life experiences, making learning more meaningful ([Rosa & Orey, 2016](#)). Furthermore, research Imam shows that ethnomathematics-based learning can help improve students' mathematical literacy skills in solving contextual problems ([Imam et al., 2020](#)). Although numerous studies have examined mathematical literacy and ethnomathematics, research specifically exploring students' difficulties in solving Wonosobo ethnomathematics-based PISA mathematical literacy questions remains limited. Therefore, this study is crucial to fill this research gap.

Based on the description above, the purpose of this study is to describe students' difficulties in solving Wonosobo ethnomathematics-based PISA mathematical literacy questions and to identify the types of difficulties at each stage of mathematical literacy: formulate, employ, and interpret. It is hoped that the results of this study will contribute to the development of mathematics learning that is more contextual, meaningful, and tailored to students' needs.

2. Method

This study uses a qualitative approach with a descriptive qualitative research type that aims to describe in depth students' errors in solving PISA mathematical literacy questions based on Wonosobo ethnomathematics. The qualitative approach was chosen because this study focuses on an in-depth understanding of the thinking process, the form of errors, and the factors that influence students in solving mathematical literacy problems at each stage of formulate, employ, and interpret based on the PISA framework ([OECD, 2023](#)). Qualitative research is used to understand phenomena in depth based on the perspective of the research subject in a natural context ([Creswell, 2018](#)).

The research subjects were selected using purposive sampling, taking into account the varying levels of students' mathematical literacy abilities. Purposive sampling was used because the researchers selected subjects who were considered capable of providing in-depth information in line with the research objectives ([Sugiyono, 2016](#)). Subject selection was based on the results of a mathematical literacy test administered at the initial stage of the study to determine student categories for further in-depth analysis. The research subjects consisted of

six students representing high, medium, and low mathematical literacy ability categories, thus allowing for a diverse picture of the errors students encountered.

To classify students' mathematical literacy abilities, the scores obtained from the mathematical literacy test were grouped into three categories adapted from ([Arikunto, 2018](#)). This categorization served as the basis for selecting interview participants through purposive sampling.

Table 1. Mathematical Literacy Level Category

Grade	Category
$X < 55$	Low
$55 \leq X < 85$	Medium
$X \geq 85$	High

In addition to considering the level of mathematical literacy ability, this study also grouped students based on the category of mathematical self-efficacy to obtain a more comprehensive picture of the factors that influence students' errors in solving ethnomathematics-based PISA mathematical literacy questions. Self-efficacy measurements were conducted using a questionnaire compiled based on the dimensions of magnitude, strength, and generality proposed by Bandura and adapted to the context of mathematics learning. The questionnaire scores were classified into high, medium, and low categories using intervals based on empirical scores so that they could be used as a basis for purposive selection of interview subjects ([Schunk & DiBenedetto, 2020](#)). In addition to considering the level of mathematical literacy ability, this study also grouped students based on the category of mathematical self-efficacy to obtain a more comprehensive picture of the factors that influence students' errors in solving ethnomathematics-based PISA mathematical literacy questions. Self-efficacy was measured using a questionnaire based on Bandura's dimensions of magnitude, strength, and generality, adapted to the context of mathematics learning. Questionnaire scores were classified into high, medium, and low categories using intervals based on empirical scores, thus providing a basis for purposive interview subject selection ([Schunk & DiBenedetto, 2020](#)).

Data collection techniques in this study included a mathematical literacy test, in-depth interviews, and documentation of student work. The mathematical literacy test was used to identify students' abilities in solving PISA-based problems that incorporate the Wonosobo ethnomathematics context. Mathematical literacy is an individual's ability to formulate, apply, and interpret mathematics in various real-life contexts ([OECD, 2023](#)). Next, in-depth interviews were conducted to gather information about students' thought processes, the types of errors they experienced, and the factors that caused these errors for each indicator of mathematical literacy. Documentation was used to support the data in the form of student results during the research.

The mathematical literacy test instrument used consists of three descriptive questions developed based on the PISA 2022 assessment framework with various ability levels, namely level 2 to level 5. The three questions are designed to measure three main competencies of mathematical literacy, namely formulating (formulating situations mathematically), applying (applying mathematical concepts, facts, procedures, and reasoning), and interpreting and evaluating (interpreting and evaluating mathematical results in real contexts) as described in the PISA framework ([OECD, 2023](#)). The Wonosobo ethnomathematics context is integrated through various local cultural elements, such as traditions, architecture, tourism potential, handicrafts, and economic activities of the local community so that the problems presented are closer to students' experiences and support contextual learning ([Rosa & Orey, 2016](#)).

The instrument validation process involved three validators with competencies relevant to the research field: two mathematics education lecturers with expertise in mathematical literacy and ethnomathematics, and one experienced mathematics teacher familiar with the

implementation of learning in secondary schools. Validation was conducted on aspects of content relevance, question construction, language clarity, and the representation of PISA mathematical literacy indicators. The content validity was analyzed using Aiken's V, and all items achieved coefficients above the acceptable threshold ($V > 0.80$), indicating that the instruments possessed high content validity and were appropriate for data collection. Minor revisions suggested by the validators were incorporated before the instruments were administered to the research subjects.

The research instruments, consisting of test questions and interview guides, were first validated through expert validation to ensure the appropriateness of the content, construct, and language used. Instrument validity is necessary to ensure the instrument accurately measures the aspects it is intended to measure ([Cohen et al., 2017](#)). The validity of the data in this study was maintained through technical triangulation and source triangulation. Technical triangulation was conducted by comparing data from tests, interviews, and documentation, while source triangulation was conducted by comparing information obtained from several research subjects to ensure data consistency. Triangulation was used to increase the credibility and trustworthiness of qualitative research results ([Moleong, 2021](#)).

Data analysis was carried out using the interactive analysis model of Miles, Huberman, and Saldana which includes data reduction, data presentation, and drawing conclusions ([Miles et al., 2014](#)). In the data reduction stage, researchers selected and focused on data related to students' errors in solving mathematical literacy problems. Next, the data was presented in narrative form, tables, and interview excerpts to facilitate interpretation. The final stage, namely drawing conclusions, is carried out by identifying student error patterns at each stage of mathematical literacy: formulating, applying, and interpreting.

3. Results and Discussion

This study involved 24 seventh-grade B students. Data were obtained through a Wonosobo ethnomathematics context-based mathematical literacy test. The data were then analyzed to identify the types of errors students made in solving mathematical literacy problems across each indicator of mathematical literacy: formulate, employ, and interpret.

Mathematical literacy levels in this study were analyzed based on students' mathematical literacy ability categories. According to the Organization for Economic Co-operation and Development (Organization for Economic Co-operation and Development) through the Programme for International Student Assessment (PISA) framework, mathematical literacy is an individual's ability to formulate, employ, and interpret mathematics in various real-life contexts. This ability indicates the extent to which students can use mathematical concepts and procedures to solve contextual problems.

In this study, students' mathematical literacy levels were categorized into three categories based on the following score intervals. ([Arikunto, 2018](#))

Table 2. Mathematical Literacy Level Category

Grade	Category
$X < 55$	Low
$55 \leq X < 85$	Medium
$X \geq 85$	High

Information: X is the average value

Based on the analysis of the mathematical literacy test, the average score was 52.77, indicating that students' mathematical literacy skills were categorized as low. This low ability

shows that students still experience errors in understanding contextual problems, building mathematical models, using mathematical concepts appropriately, and interpreting solution results. This indicates that students are not yet accustomed to solving mathematical literacy problems based on everyday life contexts, especially problems that require reasoning and problem-solving.

This is in line with the opinion [OECD \(2023\)](#) which states that students with low mathematical literacy skills are generally unable to use mathematical knowledge effectively in real-life situations and still experience errors in the process of formulating, applying, and interpreting. Furthermore, low mathematical literacy skills indicate that students are not accustomed to facing problems that require reasoning, problem-solving, and the application of mathematical concepts in everyday life contexts. This finding is also in line with research [Munfarikhatin et al. \(2022\)](#) which states that students' mathematical literacy skills in Indonesia are still low based on the results of the PISA study because students are not yet accustomed to solving context-based and reasoning problems. [Fadillah & Ni'Mah \(2019\)](#) research revealed that most student errors occurred in the interpretation indicator, namely when returning the calculation results to the context of the problem so that the solution obtained did not match the meaning of the question.

As a follow-up to the results of the mathematical literacy test, six research subjects were selected for in-depth analysis based on student work. The analysis was conducted to determine the characteristics of student errors in each indicator of mathematical literacy: formulating, employing, and interpreting. The following is a list of student samples based on the results of the mathematical literacy test.

Table 3. Sample Mathematical Literacy Results

Name	Grade	Self-Efficacy Criteria
T1	100	High
T2	88.88	
S1	66.66	Medium
S2	55.55	
R1	11.11	Low
R2	0	

T1 Subject Analysis

In general, the analysis results show that students' abilities in solving PISA mathematical literacy problems based on Wonosobo ethnomathematics differ across each indicator of mathematical literacy. Students with high literacy abilities tend to be able to formulate problems into mathematical models, apply concepts and procedures appropriately, and interpret results according to the given context. On the other hand, students with medium and low abilities still face various errors, such as the inability to identify important information in the problem, errors in selecting or applying solution procedures, and inaccurate interpretation of calculation results in the context of the problem. These findings indicate that students' error patterns do not only appear at the stage of solving mathematics problems, but also in the process of understanding the context and communicating the meaning of the results obtained.

The image shows handwritten mathematical solutions for three problems, each marked with a score of 3.

Problem 1:

Jawab

a. $180 - 120 + 76 - 150$
 $= 280$

b. 280

c. terjadi penurunan terbanyak yaitu pada hari ke-4 karena jumlahnya 280

Problem 2:

a. $150 - 74 - 90 + 40$
 126 yang tersisa pada hari Kamis yaitu 126 kg

b. Belum mencukupi, kantong yang tersisa hanya 126 kg

Problem 3:

a. Belum, karena pada jam 20.00 suhu tersebut menjadi -2°C

b. $3^{\circ}\text{C} - 2^{\circ}\text{C} - 2^{\circ}\text{C} - 2^{\circ}\text{C} = -3^{\circ}\text{C}$

Figure 1. Subject T1 Results

Q: "Of the entire problem-solving process, which part was the most difficult for you: formulating the problem, using concepts, or interpreting the results? Explain why."

T1: "The most difficult part was interpreting the results, because I had to adapt the answer to the context of the problem. But I still understood it."

Based on the interview results, the student demonstrated a good understanding of each stage of mathematical literacy. These findings indicate that the student was able to optimally implement the "formulate," "employ," and "interpret" indicators and was able to solve problems based on ethnomathematics contexts in a coherent and systematic manner.

T2 subject analysis

According to the PISA mathematical literacy framework, the formulate indicator emphasizes students' ability to recognize the mathematical aspects of a situation, identify relevant information, and represent the problem in a mathematical form or model before solving it. Therefore, even if a student obtains the correct final answer, the absence of a mathematical model or explicitly written mathematical representation indicates that the formulation process has not been carried out completely and is therefore classified as an error in the formulate indicator (OECD, 2023). This criterion is also in line with research stating that the ability to formulate problems is an essential initial stage in mathematical literacy and needs to be demonstrated through the process of transforming a real-world context into an appropriate mathematical model before performing calculations.

1. Jawab : $480 - 120 + 75 - 150 = 385$
 $480 - 120 = 360 + 75 = 435 - 150 = 285$

2. Jawab : 285

3. Jawab : Pada hari ke 4 karena, 150 orang berkurang
 280

1. Jawab : $250 - 75 - 90 = 175 - 90 = 85 + 40 = 125$

2. Jawab : tidak cukup karena cuma ada 125 kg

1. Tidak karena suhu seharusnya adalah 3°C

2. $18.00 = -3^{\circ}\text{C}$
 $20.00 = -1^{\circ}\text{C}$
 $22.00 = 1^{\circ}\text{C}$
 $24.00 = -3^{\circ}\text{C}$

Figure 2. Subject T2 Results

Q: "Of the entire problem-solving process, which part was the most difficult for you: formulating the problem, using concepts, or interpreting the results? Explain why."

T2: "The most difficult part was formulating the problem, because I found it easier to calculate directly than to write a mathematical model first. Writing the mathematical model felt longer."

Based on the interview results, students tended to focus more on the final answer than on the solution process. This finding indicates that students have good numeracy skills, but are not yet accustomed to systematically constructing mathematical models, which can lead to errors on more complex problems.

S1 subject analysis

Based on the students' work, they were able to understand the problem and write simple mathematical models using the formula indicator, such as the operation " $480 - 120 + 75 - 150$ " and the temperature operation in question 3. However, in the employ indicator, students still encountered calculation errors and had not written down the complete solution steps, resulting in a lack of systematic use of mathematical concepts. In the interpret indicator, students attempted to interpret the answer according to the context of the problem, but the explanations provided were still imprecise and did not align with the correct calculation results. The following are the results of an interview with an undergraduate student.

Jawab

1. $480 - 120 + 75 - 150$
 B. 280

< penurunan jumlah paling banyak ada di hari ke 4

2. A. 40 kg kentang
 B. benar, karena saat hari Kamis cuma 40 kg kentang yang harusnya 150 kg

2. Salah karena pukul 24.00 suhu akan menjadi -3°C

B. $3^{\circ}\text{C} - 2^{\circ}\text{C} - 2^{\circ}\text{C} - 2^{\circ}\text{C} = -3^{\circ}\text{C}$

Figure 3. Subject S1 Results

Q: "Of the entire problem-solving process, which part was the most difficult for you: formulating the problem, using concepts, or interpreting the results? Explain why."

S1: "The most difficult part was using concepts, because I often got confused when calculating and was afraid of making a calculation error."

Based on the interview results, students tended to be less thorough in the calculation process and were not yet accustomed to writing down the solution steps systematically. These findings indicate that students are able to understand the problem, but still experience errors in using and interpreting indicators, namely applying mathematical concepts and interpreting results according to the context of the problem.

S2 subject analysis

Based on the results of the students' work, students with moderate self-efficacy were able to formulate problems effectively, such as writing the operational model " $480 - 120 + 75 - 150$." However, in the implementation indicator, students still make mistakes because they tend to immediately write the final answer without showing the completion steps systematically. This indicates that students are not yet able to apply mathematical concepts procedurally and in a structured manner. The following is the result of an interview with S2.

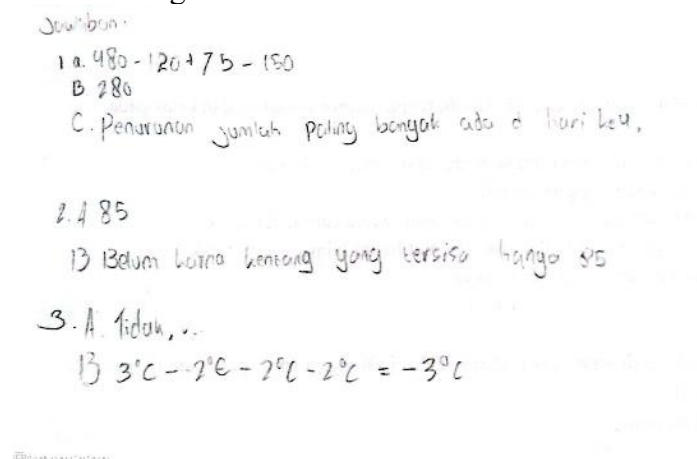


Figure 4. Subject S2 Results

Q: "Of the entire problem-solving process, which part was the most difficult for you: formulating the problem, using concepts, or interpreting the results? Explain why."

S2: "The most difficult part was using concepts because I often got confused when calculating. So I preferred to immediately write the final answer rather than writing down the steps."

Based on the interview results, students understood the problems given, but were unable to demonstrate the complete and coherent solution process. This finding indicates that the main error lies in the employ indicator because students are still oriented towards the final answer and are not yet accustomed to writing down the solution steps systematically.

R1 subject analysis

Based on the students' work, they were able to understand the information in the problem and construct simple mathematical models using the formula indicator, such as writing the operation " $480 - 120 + 75 - 150$ " and understanding the temperature context down to " -2°C ." However, students still encountered errors in the employ and interpret indicators. In the employ indicator, students were less thorough in performing arithmetic operations and had not written down the solution steps systematically, resulting in inaccurate calculations. Meanwhile, in the interpret indicator, students attempted to interpret the answer according to the context of the

problem, but their explanations were still simple and not supported by clear mathematical reasoning. The following is an interview with student R1.

Jawaban

1. a. $480 - 120 = 360$ $360 + 150 = 510$ $510 - 225 = 285$

b. Jumlah pengunjung hari ke empat adalah 285

c. Jumlah penurunan ~~pengunjung~~ pengunjung terbanyak adalah di hari ke empat

2. a. $1480 - 25 = 1455$ $1455 - 85 = 1370$

3. a. ya

b. karena sangat dingin sampai -12°

Figure 5. Subject R1 Results

Q: "Of the entire problem-solving process, which part was the most difficult for you: formulating the problem, using concepts, or interpreting the results? Explain why."

R1: "Using concepts was the most difficult because I sometimes get confused when calculating and am afraid of making mistakes. This is especially true when there are a lot of numbers, so I often just write the answer straight away."

Based on the interview, students experienced difficulties in the employ indicator because they were not yet accustomed to using mathematical concepts systematically and carefully. These findings indicate that students have initial abilities in understanding problems, but still experience errors in applying mathematical concepts and interpreting results according to the context of the problem.

R2 subject analysis

Jawab:

1. a. $480 - 120 = 360$ $360 + 150 = 510$ $510 - 105 = 405$

b. 105 Pengunjung

c. Pada hari keempat karena jumlah pengunjung berkurang lebih banyak dari hari lainnya.

2. a. 30kg

b. kurang karena sisanya hanya 90kg

3. a. benar

b. -

Figure 6. Subject R2 Results

Based on the results of student work, students with low self-efficacy still experience errors in formulating, applying, and interpreting indicators. Students tended to immediately perform calculations without systematically constructing mathematical models. For the employ indicator, students immediately wrote down the final answer without showing the solution steps, indicating that they were unable to apply mathematical concepts correctly and in a structured

manner. Furthermore, for the interpret indicator, students were unable to provide logical explanations and mathematical reasons for their answers. The following is an interview with student R2.

Q: "Of the entire problem-solving process, which part was the most difficult for you: formulating the problem, using concepts, or interpreting the results? Explain why."

R2: "The most difficult part was formulating the problem and using concepts, because I was confused about understanding the problem and didn't know where to start. I also had errors determining which mathematical concepts to use."

Based on the interview results, students experienced difficulties in understanding the problem, determining mathematical concepts, and systematically developing solution steps. These findings indicate that students' mathematical literacy skills are still low, especially on the formulate and employ indicators. Therefore, students require structured guidance and practice in solving mathematical problems.

Based on the results of research conducted on grade VII B students, it can be concluded that students' mathematical literacy skills are still in the low category with an average score of 52.77. This low mathematical literacy ability indicates that students still experience errors in understanding contextual problems, building mathematical models, using mathematical concepts appropriately, and interpreting solution results according to the context of the problem. This indicates that students are not yet accustomed to solving mathematical literacy problems based on everyday life contexts that require reasoning and problem-solving skills.

The results of the analysis of student errors based on mathematical literacy indicators show that student errors occur at each stage of mathematical literacy: formulate, employ, and interpret. In the formulate indicator, some students were able to understand the information in the problem and construct a simple mathematical model, but there were still students who immediately performed calculations without writing the mathematical model systematically. Errors at this stage indicate that students are not yet accustomed to representing contextual problems in a complete and coherent mathematical form. In line with the findings of this study, [Pranitasari & Ratu \(2020\)](#) revealed that students often make transformation errors, namely being unable to transform contextual problems into a mathematical form that can be used for the solution process. This condition indicates that students' ability to connect contextual problems with mathematical concepts is still low, and learning tends to emphasize calculation skills rather than understanding and formulating problems. Therefore, learning is needed that trains students to understand problems gradually by getting used to writing down known information, questions, and mathematical models before performing calculations. The use of mathematical literacy problems based on real-world contexts and ethnomathematics, as well as providing scaffolding, can also help students construct mathematical models systematically.

After analyzing the work and interview results of all six research subjects, different error patterns were identified across the three mathematical literacy indicators, namely formulate, employ, and interpret. Although each subject demonstrated unique characteristics, several common patterns emerged according to their level of mathematical literacy. To provide a clearer comparison of the similarities and differences in students' errors, a summary of the error patterns identified across all research subjects is presented in Table 4.

Table 4. Summary of student error patterns for each mathematical literacy indicator

Subject	Literacy Category	Formulate	Employ	Interpret	Dominant Error Patterns
T1	High	There are no errors.	There are no errors.	A minor error in fitting the results to the context but does not affect the answer.	Able to meet all mathematical literacy indicators.
T2	High	Not writing the mathematical model explicitly.	There are no errors.	There are no errors.	Tends to immediately perform calculations without a complete formulation process.
S1	Medium	Able to construct simple mathematical models.	Miscalculations and unsystematic solution steps.	Interpretation is less in accordance with the calculation results.	Errors in the use of concepts and interpretation of results.
S2	Medium	Able to compile mathematical models.	Not writing down the settlement procedure systematically.	The interpretation is quite good.	Oriented towards the final answer without showing the solution process.
R1	Low	Able to construct simple mathematical models.	Errors in procedures and arithmetic operations.	The interpretation is still simple and not supported by mathematical reasons.	Errors in the application of concepts and interpretation.
R2	Low	Unable to build a mathematical model.	Unable to apply problem-solving concepts and procedures.	Unable to relate results to context.	Experiencing errors in all indicators of mathematical literacy.

In the employ indicator, most students experience errors using mathematical concepts and carrying out calculation procedures correctly. Students tend to immediately write the final answer without showing the solution steps completely and systematically. Furthermore, some students also make calculation errors due to a lack of thoroughness in using mathematical operations. This conclusion is based on the analysis of all research subjects, which showed that most students made errors at the employ stage, such as inaccurate selection of solution procedures, errors in arithmetic operations, and an inability to apply mathematical concepts appropriately to the given problem. The frequency of errors in this indicator was higher than in the formulate and interpret indicators, so errors at the employ stage were categorized as the most dominant form of errors in this study. This finding is supported by [Qadry et al. \(2022\)](#) research that indicates that errors at the employ stage generally occur due to students' low accuracy in performing arithmetic operations and weak conceptual understanding. Errors in the employ indicator indicate that students are unable to apply mathematical concepts procedurally and systematically. Students tend to be oriented towards the final answer, often ignoring the solution steps. As a result, students are prone to errors in arithmetic operations, procedures, and the use of mathematical concepts. This condition indicates that learning still emphasizes the final result rather than the mathematical thinking process.

In the interpret indicator, students also still have errors interpreting the solution results according to the context of the problem. Some students have attempted to provide explanations in sentence form, but their interpretations are still simple and not supported by precise mathematical reasoning. This indicates that students are not yet able to optimally connect the results of mathematical calculations with meaning in real-life contexts. This finding aligns with

[Fadillah & Ni'mah \(2019\)](#) research which states that the interpretation indicator is the most challenging because students are unable to accurately connect mathematical results to real-life contexts. This condition indicates that students' ability to relate mathematical concepts to everyday life is still low, and learning still emphasizes calculation skills rather than interpreting results. Therefore, learning is needed that trains students to explain the meaning of results contextually by getting used to writing conclusions, mathematical reasoning, and using mathematical literacy and ethnomathematics problems related to everyday life.

Based on interviews, the difficulties experienced by students generally lie in the concept application stage (employment). Students admitted to often being confused when performing calculations, fearing mistakes, and not being accustomed to writing complete solution steps. Furthermore, some students also experienced errors formulating problems because they were unable to determine an appropriate mathematical model based on the information in the problem. Students with low mathematical literacy skills tend to skip the solution steps and immediately write the final result ([Nugroho et al., 2020](#)).

4. Conclusion

Based on the research results, it can be concluded that students' mathematical literacy skills are still relatively low, and errors were found in each indicator of mathematical literacy: formulate, employ, and interpret. In the formulate indicator, students experienced errors in systematically constructing mathematical models from contextual problems. In the employ indicator, which was the most dominant error, students were unable to apply mathematical concepts and procedures accurately and systematically. Meanwhile, in the interpret indicator, students still had errors interpreting calculation results and correctly relating them to the problem context.

Therefore, more contextual and meaningful mathematics learning is needed so that students become accustomed to formulating, applying, and interpreting problem-solving systematically. Ethnomathematics-based learning can be an alternative to improving students' mathematical literacy skills through a cultural context close to everyday life.

5. References

- Anjarrani, G., & Kurniasih, M. D. (2023). Analisis Kesulitan Siswa Smp Dalam Menyelesaikan Soal Literasi Matematika Berdasarkan Self Efficacy Siswa. *Jurnal Pendidikan Matematika (JPM)*, 9(2), 132–142. <https://doi.org/10.33474/jpm.v9i2.20092>
- Arikunto, S. (2018). *Dasar-Dasar Evaluasi Pendidikan Edisi 3* (3rd ed.). Bumi Aksara.
- Awaji, B. M., Abdel-Hamid, R. H., Khalil, I. A., & Prahmana, R. C. I. (2025). Mathematics Teachers' Practices in Light of The Effective Teaching Practices. *Infinity Journal*, 14(1), 1–20. <https://doi.org/10.22460/Infinity.V14I1.P1-20>
- Cohen, L., Manion, L., & Morrison, K. (2017). Research Methods in Education. In *Research Methods in Education* (8th ed.). Routledge. <https://doi.org/10.4324/9781315456539>
- Creswell, J. W. (2018). *Research Design: Qualitative, Quantitative, and Mixed Methods*. Publications.
- D'Ambrosio, U. (2016). *An Overview of the History of Ethnomathematics*. In: Current and Future Perspectives of Ethnomathematics as a Program. ICME-13 Topical Surveys. Springer, Cham. https://doi.org/10.1007/978-3-319-30120-4_2
- Fadillah, A., & Ni'mah, N. (2019). Analisis Literasi Matematika Siswa Dalam Memecahkan Soal Matematika PISA Konten Change and Relationship. *Jurnal Teori Dan Aplikasi Matematika*, 3(2), 127–131. <https://doi.org/10.31764/JTAM.V3I2.1035>

- Fitria, M., Ubaidah, N., & Basir, M. A. (2025). Profil Literasi Matematika Siswa Berdasarkan Self-Efficacy Pada Penyelesaian Soal PISA Konten Quantity. *Cartesian: Jurnal Pendidikan Matematika*, 4(02), 82–93. <https://doi.org/10.33752/Cartesian.V4I02.6373>
- Goos, M., Geiger, V., & Dole, S. (2014). *Transforming Professional Practice in Numeracy Teaching*. 81–102. https://doi.org/10.1007/978-3-319-04993-9_6
- Hasanah, N., Purnomo, E. A., & Mawarsari, V. D. (2024). Implementasi Website Virtual Reality Tour Berbasis Etnomatematika Untuk Meningkatkan Literasi Matematika Siswa. *Jurnal Karya Pendidikan Matematika*, 11(1), 127–137. <https://doi.org/10.26714/JKPM.11.1.2024.127-137>
- Hayati, M., & Jannah, M. (2024). Pentingnya Kemampuan Literasi Matematika Dalam Pembelajaran Matematika. *Journal of Mathematics Education and Application*, 4(1), 40. <https://mathjournal.unram.ac.id/index.php/Griya/indexGriya>
- Imam, F., Zaenuri, Z., & Nugroho, S. E. (2020). Mathematical Literacy Ability in Learning Problem-Based Learning with Ethnomatic Mathematics Based on Student Learning Styles. *Unnes Journal of Mathematics Education Research*, 9(2), 131–138. <https://journal.unnes.ac.id/sju/ujmer/article/view/32821>
- Jahra, L. S., Hasanah, A., & Sudihartini, E. (2024). Kemampuan Literasi Matematis Siswa SMP Dalam Menyelesaikan Soal Matematika Tipe HOTS Ditinjau Dari Self-Efficacy. *SIGMA DIDAKTIKA: Jurnal Pendidikan Matematika*, 12(2), 148–159. <https://doi.org/10.17509/SIGMADIDAKTIKA.V12I2.89603>
- Lestari, F. A., & Wulantina, E. (2024). Analysis of Mathematical Literacy in Solving PISA Questions Based in Ethnomathematics in Junior High School Students. *Unnes Journal of Mathematics Education*, 13(1), 96–103. <https://doi.org/10.15294/6S2C6T07>
- Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). *Qualitative Data Analysis: a Methods Sourcebook*. SAGE Publications.
- Moleong, L. J. (2021). *Metodologi Penelitian Kualitatif*. PT Remaja Rosdakarya.
- Munfarikhatin, A., Pagiling, S. L., & Natsir, I. (2022). Fenomena Literasi Matematika Siswa di Indonesia Berdasarkan Hasil PISA. *Jurnal Pembelajaran Dan Pengembangan Matematika*, 2(1), 49–58. <https://doi.org/10.36733/PEMANTIK.V2I1.3664>
- Munthahana, J., Budiarto, M. T., & Wintarti, A. (2023). The Application of Ethnomathematics in Numeracy Literacy Perspective: A Literature Review. *Indonesian Journal of Science and Mathematics Education*, 6(2), 177–191. <https://doi.org/10.24042/IJSME.V6I2.17546>
- Nugroho, H. A., mulyono, M., & Hidayah, I. (2020). Mathematical Literacy in Discovery Learning with Scaffolding Strategy Reviewed from Self-Efficacy. *Unnes Journal of Mathematics Education Research*, 9(1), 44–51. <https://journal.unnes.ac.id/sju/ujmer/article/view/30455>
- OECD. (2023). PISA 2022 Results (Volume I): The State of Learning and Equity in Education. *PISA, PISA*. <https://doi.org/10.1787/53F23881-EN>
- Pranitasari, D., & Ratu, N. (2020). Analisis Kesalahan Siswa Dalam Menyelesaikan Soal Matematika PISA Pada Konten Change and Relationship. 9(4), 1235–1248. <https://doi.org/10.24127/ajpm.v9i4.2685>
- Pratama, R. A., & Yelken, T. Y. (2024). Effectiveness of Ethnomathematics-Based Learning on Students' Mathematical Literacy: A Meta-Analysis Study. *Discover Education 2024 3:1*, 3(1), 202-. <https://doi.org/10.1007/S44217-024-00309-1>
- Qadry, I. K., Dassa, A., & Aynul, N. (2022). Analisis Kemampuan Literasi Matematika Siswa Dalam Menyelesaikan Soal PISA Konten Space and Shape Pada Kelas IX SMP Negeri 13 Makassar. *Infinity: Jurnal Matematika Dan Aplikasinya*, 2(2), 78–92. <https://doi.org/10.30605/27458326-99>

- Ramadhani, R., Syahputra, E., & Simamora, E. (2023). Ethnomathematics Approach Integrated Flipped Classroom Model: Culturally Contextualized Meaningful Learning and Flexibility. *Jurnal Elemen*, 9(2), 371–387. <https://doi.org/10.29408/jel.v9i2.7871>
- Rosa, M., & Orey, D. C. (2016). *State of the Art in Ethnomathematics*. In: Current and Future Perspectives of Ethnomathematics as a Program. ICME-13 Topical Surveys. Springer, Cham. 11–37. https://doi.org/10.1007/978-3-319-30120-4_3
- Schunk, D. H., & DiBenedetto, M. K. (2020). Motivation and Social Cognitive Theory. *Contemporary Educational Psychology*, 60, 101832. <https://doi.org/10.1016/J.CEDPSYCH.2019.101832>
- Selan, M., Daniel, F., & Babys, U. (2020). Analisis Kemampuan Literasi Matematis Siswa Dalam Menyelesaikan Soal PISA Konten Change and Relationship. *AKSIOMA: Jurnal Matematika dan Pendidikan Matematika*, 11(2), 335–344. <https://doi.org/10.26877/AKS.V11I2.6256>
- Sugiyono. (2016). *Metode Penelitian Kuantitatif Kualitatif dan R&D*. Alfabeta.
- Widianti, W., & Hidayati, N. (2021). Analisis Kemampuan Literasi Matematis Siswa SMP Pada Materi Segitiga dan Segiempat. *Jurnal Pembelajaran Matematika Inovatif*, 4(1), 27–38. <https://journal.ikipsiliwangi.ac.id/jpmi/article/view/6369>
- Yanto, A. D., & Rahaju, E. B. (2024). Literasi Matematika Peserta Didik SMP Berdasarkan Mathematics Self-Efficacy Pada Masalah Statistika Adaptasi PISA. *Mathedunesa*, 13(2), 660–673. <https://doi.org/10.26740/mathedunesa.V13N2.P660-673>