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The Process of Mathematical Literacy in Middle School Students: Analyzing the Role of Mathematical Dispositions

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Abstract: Mathematical literacy extends beyond solving equations to applying mathematical concepts in everyday life. This study investigated the development of mathematical literacy and the challenges students face, analyzed through their mathematical dispositions. A qualitative case study methodology was employed, utilizing a PISA-equivalent test, a mathematical disposition questionnaire, and interviews. 40 7th-grade students were classified into high, moderate, and low disposition groups, with a detailed analysis of three representative students from each group. The Results indicated that students with high mathematical dispositions solved problems effectively, students could formulate the mathematical problem, apply mathematical concepts, and interpret real-world outcomes. Conversely, those with moderate and low dispositions struggled to apply relevant concepts and could only identify given information for problem-solving. These challenges are associated with a lack of understanding of fundamental concepts, particularly proportional reasoning. Factors such as motivation, interest, self-confidence, and attitudes toward mathematics significantly influence students' dispositions and their mathematical literacy skills.

Keywords: mathematical literacy, mathematical literacy process, mathematical disposition.

▪ INTRODUCTION

Globalization and technological advancements bring complex xhallenges, especially in the 21st century. Mathematical literacy is crucial for acquiring 21st-century skills (Julie et al., 2017). According to the World Economic Forum, essential 21st-century skills encompass basic literacy, competence, and character. Basic literacy includes reading literacy, mathematics literacy, digital skills, science, financial literacy, and cultural awareness (Harun et al., 2020). For sustainable living in the 21st century, there is a significant expectation for students to develop their mathematical literacy skills. Mathematical literacy is a person's skill in formulating, employing, and interpreting mathematics as a tool for solving everyday problems (Ojose, 2011).

Mathematical literacy extends beyond solving equations; it encourages students to understand and apply mathematical concepts in everyday life. Mathematical literacy is closely related to the application of mathematics, reasoning, intuitive imagination, mathematical modeling, and mathematical emotions (Li, 2020). Developing mathematical literacy skills helps bridge the gap between theoretical knowledge and practical application (Sitopu et al., 2024). Contextual challenges promote critical thinking and the development of problem-solving skills necessary for various real-life situations (Davis & Simmt, 2014). Therefore, students need to be equipped with mathematical literacy skills to face the complex challenges of the 21st century (Schoenfeld, 2020).

Integrating mathematical literacy is a strategic investment in the future of education and societal development (Sitopu et al., 2024). High mathematical literacy is essential for developing globally competitive human resources. The OECD monitors the readiness of 15-year-old students to face future challenges through the PISA (Programme for International Student Assessment) program, which evaluates reading literacy, science

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literacy, and mathematical literacy. Despite Indonesia's active participation in PISA, the mathematical literacy skills of Indonesian students have not improved significantly.

The literacy levels in reading and mathematics among Indonesian children are significantly low. Approximately 70% of Indonesian students have low literacy levels, struggling to identify the main idea in sentences or longer texts, similarly, around 72% of students exhibit low mathematical literacy skills, with many unable to solve simple math problems, even in familiar contexts with provided information (OECD, 2019). From 2000 to 2022, Indonesia consistently ranked in the bottom 10 of all participating countries in the PISA assessments, and never reached the OECD's minimum benchmark of 500 points (OECD, 2023).

PISA evaluates the mathematical literacy skills of 15-year-old students, the majority of whom are junior high school students. However, several findings have revealed that junior high school students could not solve mathematical literacy problems well. Harisman et al. (2023) found that among 15 students from 5 different junior high schools, there were only 2 students who had high mathematical literacy skills. Another finding revealed that students' difficulty in mathematical literacy is the mathematization process (Kholid et al., 2022). Junior high school students cannot solve mathematical literacy problems that require mathematical representation and interpretation of mathematical results because they are only familiar with procedural problems (Nurhanurawati et al., 2022). This problem stems from teaching practices, as students spend time practicing procedures shown on the blackboard (Bolstad, 2023).

Several factors contribute to students' mathematical literacy skills. Socioeconomic status significantly affects their performance on PISA (Perry & Mcconney, 2010), including parental educational attainment (O'Connell, 2019) and changes in family circumstances (Marks & O'Connell, 2021). Access to comprehensive facilities and a supportive learning environment enhance students' learning effectiveness. Besides external factors like socioeconomic status, internal factors also impact students' mathematical literacy scores on PISA (Ding, 2016). The internal factors include self-efficacy (Nisa & Arliani, 2023), mathematics anxiety (Karaboğa et al., 2022), and mathematical disposition (Rahmanuri et al., 2023). These internal factors are included within the emotional dimension, (McLeod, 1992) proposed that the emotional dimension should encompass three components: beliefs, attitudes, and emotions.

The differences in the process carried out by students between classes when solving problems contribute to their low mathematical literacy skills (Lahinda & Jailani, 2015). Students' proficiency in mathematical literacy often halts at the problem-formulation stage (Jailani et al., 2020), they tend to effectively use mathematical concepts if they can first formulate mathematical problems, and struggle with interpreting and evaluating solutions. In contrast, Almarashdi & Jarrah (2023) found that students were more proficient in interpreting mathematical outcomes than in formulating problems and applying concepts. The obstacles faced by students in solving mathematical literacy problems turned out to be the mastery of the mathematical literacy process that was not optimal, leading to a lack of varied solutions.

The process of mathematical literacy consists of three main stages: formulating, employing, and interpreting (OECD, 2023). In the formulating stage, individuals recognize and identify opportunities to use mathematics by translating real-world problems into mathematical structures and representations, such as variables, symbols,

diagrams, and models. During the employing stage, they utilize mathematical concepts, facts, procedures, and reasoning to solve the formulated problems, which includes designing strategies and applying relevant rules and algorithms. The interpreting stage involves reflecting on the solutions and mathematical outcomes and relating them to the real-world context to ensure the results are logical and appropriate for the given situation.

Enhancing students' mathematical literacy skills presents a big challenge because students' low mathematical disposition hinders their mathematical literacy process. One indicator of mathematical disposition is the level of confidence in solving problems. The mathematical literacy assessment by PISA in 2012 even measured students' confidence, with questions such as 'How confident are you in solving the equation 3x+5=17' (OECD, 2013). When students are not confident and discouraged from solving mathematical literacy problems, they will fail to understand information and identify problems (Salistia et al., 2024), whereas identifying information and problems from the question is the first stage in the mathematical literacy process. It follows Jablonka (2003) statement, that to improve students' mathematical literacy skills, a positive mathematical disposition is needed.

Mathematical disposition is one of the five standards of mathematics proficiency. These standards include conceptual understanding, procedural skills, strategic problem-solving, adaptive reasoning, and productive disposition (Kilpatrick, 2001). In addition to mathematical skills, attitudes toward mathematics and confidence in mathematical performance must also be considered to achieve a high level of mathematical literacy(Yang et al., 2021). Students' perceptions of their abilities are reflected in their academic outcomes; those who have confidence in their abilities tend to be more engaged in mathematical tasks (Hwang & Ham, 2021). A positive perception of mathematics is essential, as it prepares individuals to confront mathematical challenges across various real-life contexts (Sikko, 2022). As indicated by the research of (Dağdelen & Yıldız, 2022), a positive attitude has a significant impact on students' mathematical skills.

Mathematical disposition refers to students' positive attitudes toward learning and solving mathematical problems (Akmal et al., 2022). Students can develop confidence in their ability to apply mathematics in real-world contexts. For instance, in financial contexts, students become confident in their ability to solve financial problems using mathematical concepts. As Ozkale and Ozdemir Erdogan (2022) stated, that finance is one of the contexts within mathematical literacy that can be integrated into mathematics lessons. Mathematical disposition includes several elements such as confidence, perseverance, learning intention, and perception of mathematics (Mayratih et al., 2019). Additionally, mathematical disposition also supports students' reflective thinking abilities by encouraging them to reflect on their mathematical solutions (Setiyani et al., 2022).

Students' mathematical disposition is an important aspect that needs to be evaluated (NCTM, 1988), which should include information about (1) students' level of confidence in using mathematics to solve problems, (2) students' flexibility when exploring ideas and giving reasons, (3) students' enthusiasm and seriousness in doing mathematical tasks, (4) interest, curiosity, and ability to work with mathematics, (5) reflection on every thought and action, (6) understanding of the usefulness of mathematics in various fields of science and everyday life, and (7) appreciation of the role of mathematics in culture.

A level of confidence in solving problems can help students when solving mathematical literacy problems (Salistia et al., 2024). Curiosity, enthusiasm, and student interest significantly affect students' ability to solve problems because they cannot solve them correctly with low interest in mathematics (Amany et al., 2023). Low student interest in mathematics is due to mathematics being abstract and difficult to understand (Rizki et al., 2022). Students' flexibility in solving problems is also very influential on students' literacy and numeracy achievement (Magalhães et al., 2020). Student reflection is needed when evaluating answers in order to maximize the process of interpreting mathematical results. Students with high mathematical dispositions can reflect on their thinking by re-evaluating the solution correctly (Salistia et al., 2024). Another aspect that is also very important is understanding and appreciating the usefulness of mathematics. Students should recognize the role of mathematics in life, but what happens is that students have a narrow view of mathematics as numbers and calculations, not as a way to prove the truth or understand real-world problems (Bolstad, 2023). Thus, all aspects of mathematical disposition are essential in solving mathematical literacy problems.

Other studies have examined mathematical literacy concerning mathematical disposition. Sulasdini and Himmah (2021) found that students with low mathematical dispositions could only solve level 1 mathematical literacy problems, while those with high dispositions demonstrated better mathematical literacy skills. Furthermore, students with high mathematical dispositions could solve mathematical literacy problems up to level 5 (Rahmawati et al., 2021). Other studies have also found that students' mathematical dispositions influence abilities necessary for mathematical literacy, such as mathematizing, mathematical communication, reasoning, and problem-solving strategies (Lestari et al., 2019).

Most previous studies have focused on the level of students' mathematical literacy achievement rather than exploring the components of the mathematical literacy process itself. Very few studies address the mathematical literacy process based on students' mathematical disposition. One such study by Salistia et al. (2024) examined this process and found that students with high mathematical dispositions could perform the entire mathematical literacy process more effectively than students with low mathematical dispositions. However, effective mathematical literacy processes only occurred in some problems. Therefore, it is essential to clarify whether students with high mathematical dispositions can perform well in all problem contexts. Moreover, Salistia et al.'s study was conducted in high school, while PISA assesses the mathematical literacy of 15-year-olds, most of whom are in secondary school. Thus, understanding the mathematical literacy process among secondary school students is important. Previous studies also did not examine the difficulties students face in solving mathematical literacy problems.

This research aims to analyze junior high school students' mathematical literacy processes concerning their mathematical dispositions, as well as the challenges they encounter in solving mathematical literacy problems. The research questions are as follows: (1) How is the mathematical literacy process of junior high school students based on their mathematical dispositions? and (2) What difficulties do students experience in solving mathematical literacy problems? By investigating these questions, this study seeks to provide insights into students' mathematical literacy processes and to suggest strategies for improving students' mathematical literacy skills.

▪ METHOD

This research used a qualitative approach with a case study design. The qualitative approach was used because this research sought to explore the meaning of the mathematical literacy process based on students' mathematical disposition. As (Creswell, 2017) explained, a qualitative approach is used to explore and understand meaning. This research used a qualitative approach with a case study design. The case in this study is the mathematical literacy process of seventh-grade students, where the characteristics of the case are different categories of mathematical disposition. As stated by (Gall et al., 2014), case studies are used to examine in more detail a case of a phenomenon.

The research instruments used were a mathematical disposition questionnaire, mathematical literacy questions equivalent to PISA, and interview guidelines. The mathematical disposition questionnaire consists of positive and negative questions made by modifying the mathematical disposition questionnaire by Fauzana (2019). The questionnaire scoring used a scale of 1 (strongly disagree), 2 (disagree), 3 (agree), and 4 (strongly agree). The questionnaire score helps researchers to categorize students' mathematical disposition.

The questionnaire has fulfilled the indicators of mathematical disposition, namely: (1) students' level of confidence in using mathematics to solve problems, (2) students' flexibility when exploring ideas and giving reasons, (3) students' enthusiasm and seriousness in doing mathematical tasks, (4) interest, curiosity, and ability to work with mathematics, (5) reflection on every thought and action, (6) understanding of the usefulness of mathematics in various fields of science and everyday life, and (7) appreciation of the role of mathematics in culture. The test instrument consisted of two PISA equivalent questions made by modifying the 2012 PISA questions with comparison material (OECD, 2012). The questions met the indicators of the mathematical literacy process as follows.

Table 1. Mathematical literacy process indicators

Mathematical Literacy Process	Indicators
Formulate	Identify several situations mathematically for problems presented in contextual form.
Employ	Apply strategies and concepts to solve mathematically formulated problems to obtain mathematical conclusions.
Interpret	Interpret the results of mathematical answers/solutions to the real-world problem. Evaluate the suitability of mathematical solutions in the context of real-world problems.

Question 1

BATAGOR

Dilah ingin membuat batagor untuk menu buka puasanya hari ini.
Sekarang ia sedang membumbui batagor yang telah ia masak menggunakan sambal batagor.
Ini adalah resep untuk 500 ml sambal batagor.

Sambal kacang instan	450 ml
Kecap manis	20 ml
Saus Sambal	30 ml

Berapa mililiter (ml) sambal kacang instan, kecap manis, dan saus sambal yang dibutuhkan jika Dilah harus membuat 900 ml sambal batagor?

Question 2

PENERIMAAN SISWA BARU

Di suatu SMP, perbandingan jumlah siswa laki-laki dengan siswa perempuan adalah 5:4. Setelah penerimaan siswa baru, jumlah siswa laki-laki bertambah 20% sedangkan jumlah siswa perempuan bertambah 50%. Tentukanlah persentase siswa perempuan dari total siswa setelah penerimaan siswa baru!

Figure 1. Mathematical literacy test (ratio and proportion topics)

The test was conducted to see students' mathematical literacy process, and the questionnaire was conducted to categorize students' mathematical dispositions. The research instrument has been validated in advance by a validator, namely a lecturer in the mathematics education study program. The interview guidelines used by researchers are semi-structured so that they can change according to conditions in the field. To maintain the credibility of the research, we triangulated the data through in-depth interviews because one way to triangulate data is through in-depth interviews (Carter et al., 2014). In addition, interviews were also conducted to find out the difficulties faced in solving mathematical literacy problems.

The subjects of this study were 40 seventh-grade students of Labschool UPI Junior High School. Subject categorization was determined based on each student's mathematical disposition. The categorization of mathematical disposition in this study used the following guidelines.

Table 2. Categorization of students' mathematical disposition

Score Range	Category
$x_i < \bar{x} - \frac{1}{2}s_i$	Low

$\bar{x} - \frac{1}{2}s_i < x_i < \bar{x} + \frac{1}{2}s_i$	Medium
$x_i > \bar{x} + \frac{1}{2}s_i$	High

The selection of three subjects from each category of mathematical disposition was conducted to facilitate analysis and conclusion. For the high mathematical disposition category, the three subjects with the highest scores were chosen, in contrast, the three subjects with the lowest scores were chosen to represent the low disposition category. And for the medium category, we chose three subjects with scores closest to the average. This selection process ensures that each subject accurately represents their respective mathematical disposition category. Furthermore, these students did a test of mathematical literacy skills. Data on the mathematical literacy process was collected by analyzing students' responses to questions. After drawing provisional conclusions about the mathematical literacy process, interviews were conducted to confirm and further explore information related to students' mathematical literacy process and their difficulties in solving mathematical literacy problems. The categories of students' mathematical dispositions are as follows.

Table 3. Students' mathematical disposition category

Mathematical Disposition Category	Number Of Students
High	10
Moderate	20
Low	10

▪ RESULT AND DISSCUSSION

The data was obtained through the initial stage of administering a mathematical disposition questionnaire. After students' mathematical disposition was categorized into low, medium, and high, the researchers gave mathematical literacy tests to 3 subjects with a high category, 3 subjects with a medium category, and 3 subjects with a low category. The following is the mathematical literacy process employed by 9 subjects.

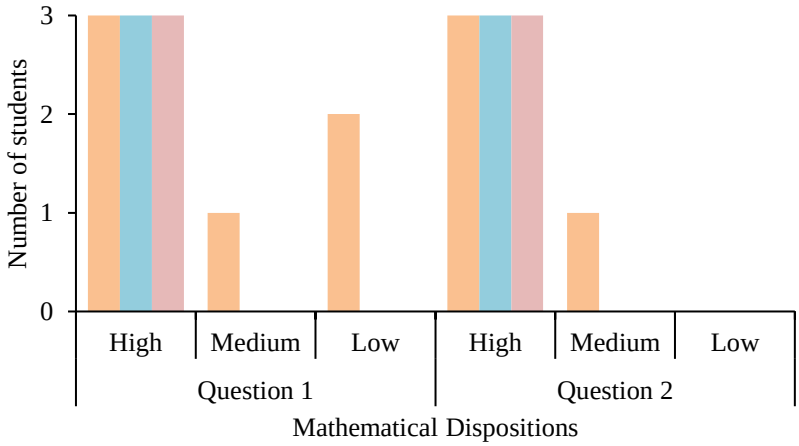

Figure 2. Students' mathematical process based on mathematical disposition

The mathematical literacy process includes formulating mathematical problems (formulate); using mathematical concepts (employ), and interpreting the results obtained into a mathematical context (interpret) (OECD, 2023). The process of formulating mathematical problems is characterized by identifying mathematical aspects of a problem in a real-world context; and representing a situation mathematically using appropriate variables, symbols, diagrams, and standard models. The process of employing mathematical concepts is characterized by applying mathematical facts, rules, algorithms, and structures; and designing and implementing strategies to find mathematical solutions. The process of interpreting mathematical results is characterized by reinterpreting mathematical results into a real-world context and explaining why the obtained mathematical results or conclusions are categorized as reasonable or unreasonable within the given problem context.

Based on figure 2, three subjects with high mathematical dispositions could carry out the entire mathematical literacy process on the two questions given. On the other hand, some subjects with medium and low mathematical dispositions could complete the formulation process on one of the questions, and some did not answer all questions. After obtaining a general description of the mathematical literacy process based on students' mathematical dispositions, the next step is to describe the mathematical literacy process for representative subjects with high, medium, and low mathematical dispositions. The following findings were obtained through analysis of students' answers to mathematical literacy questions and the results of interviews with students.

The Literacy Process of Students with High Mathematical Disposition

Students with high mathematical dispositions have gone through a systematic and complete mathematical literacy process. The following is subject 19's answer to question number 1.

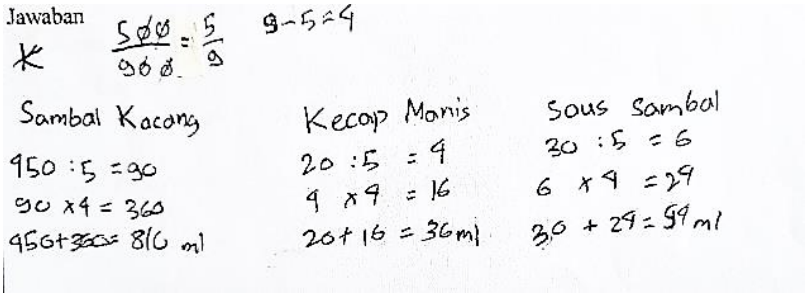

Figure 3. Mathematical literacy process by subject 19 on question number 1

Based on the figure above, it can be observed that subject 19 (S19) employed the concept of ratio. S19 compared the quantity of instant peanut sauce (ml) in the table with the given information and subsequently formed a ratio of 5:9. The next step undertaken by S19 was to divide each composition by the ratio of 5:9. However, the answer sheet reveals that S19 subtracted 5 from 9, and the resulting difference was then multiplied by the outcome of 450 divided by 5. The following outlines the difference between the researcher's solution and S19's solution.

The steps of the student's solution were slightly different from the expected steps. Nonetheless, S19 still arrived at the correct solution. This is because S19 performed the

Researcher's solution	S19's solution
$\frac{450}{5/9} = 810$	$450 : 5 = 90$ 90 x 4 + 450 = 810

elaboration at the 90 x 9 stage, transforming 90 x (4 + 5), resulting in the provided solution becoming 90 x 4 + 450. Consequently, it can be concluded that S19 has executed the employing process comprehensively and correctly.

Figure 1 shows that S19 correctly solved the problem by comparing the composition of Batagor sauce using fractions. However, the figure does not show S19 explicity identifying or writing down the given and asked information. An interview was conducted to clarify if S19 completed the formulation process, as it is a prerequisite for employing mathematical concepts. Therefore, the researcher (P) interviewed with S19, which can be seen in the following interview excerpt. Interview excerpt with S19

P: "I would like to ask about your answer to question number 1, what information was given and asked?"
S19: "The question provided that to make 500 ml Batagor chili sauce, 450 ml instant peanut sauce, 20 ml sweet soy sauce, and 30 ml chili sauce are required. The question asked for the composition to make 900 ml Batagor chili sauce."
P: "Why did you not write down the given information and the question?"
S19: "Because it would take a long time, and the information is already present in the problem. I prefer to remember it."
P: "Then, what did you do to answer this question?"
S19: "First, I compared the 500 ml with 900 ml. After dividing by 100, I got the ratio of 5:9."
P: "What mathematical concept did you use to answer this question?"
S19: "I employed the concept of ratio."
P: "After obtaining the ratio of 5:9, what's the next step?"
S19: "Initially, for the instant peanut sauce, I divide 450 ml by 5, resulting in 90. Then, for the ratio, I found the difference, 9 - 5 = 4. Subsequently, I multiplied 90 by 4, yielding 360. Therefore, the instant peanut sauce required for 900 ml Batagor sauce is 360 ml."
P: "Why did you need to find the difference between 9 and 5? Why not divide 450 by 5/9? After dividing by 5, the result could have been multiplied by 9."
S19: "Oh right, it should have been done that way. I thought it would be faster to find the difference first because I did not know how to divide it by fractions. I was confused, so I tried to subtract first."
P: "Okay. Then, how about the sweet soy sauce and chili sauce?"
S19: "The method is the same."
P: "So what's the conclusion?"
S19: "So, to make 900 ml Batagor sauce, 810 ml instant peanut sauce, 36 ml sweet soy sauce, and 54 ml chili sauce are required".

Through the interview data, it was discovered that S19 had performed the process of formulating the problem mathematically by identifying the problem in the question. S19 did not write down the known and asked information, choosing to rememberit for efficiency. Nonetheless, the formulation process can be discerned from the mathematical

structure in S19's solution steps. The subsequent process undertaken was utilizing concepts. S19 employed the concept of ratio. However, as evident from the interview excerpt, it transpired that S19 experiences difficulty in dividing fractions, being unaware that the result of a number divided by the numerator of a fraction can then be multiplied by the denominator of the fraction. S19 exhibited a poor understanding of the concept of fraction operations. Furthermore, S19 was able to interpret the process effectively. On the answer sheet, the process of interpreting the mathematical solution in the context of a real-world problem was not visible. However, it was confirmed through the interview that S19 could interpret the mathematical solution or conclusion in the context of the real world. Therefore, it can be concluded that S19, as a student with a high mathematical disposition, was able to perform the entire mathematical literacy process proficiently in problem number 1 and answer the question correctly. Likewise, in problem number 2, S19 executed the mathematical literacy process adeptly and provided accurate answers.

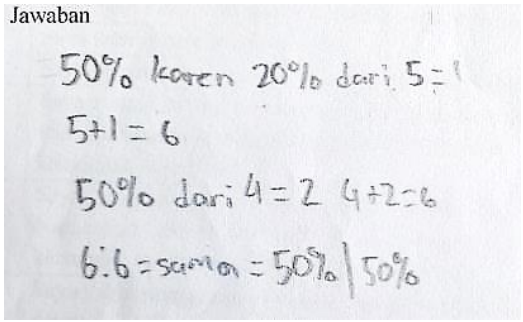

Figure 4. Mathematical literacy process by subject-26 on question number 2

The results of the mathematical literacy test on subject-26 (S26) revealed that S26 had performed the entire mathematical literacy process proficiently and answered the questions correctly. In problem number 1, S26 was able to identify the problem, formulate it mathematically, employ the concept of ratio, and interpret the results in a real-world context. However, on problem number 2, S26 appeared to only perform a simple calculation process yet produced the correct answer. An interview was conducted to gain a deeper understanding of S26's solution steps. Interview excerpt with S26

P: " I would like to ask about your answer to question number 2, what information was given and asked?"
S26: "I know the ratio of female and male students, the male students increased by 20% while the female students increased by 50%, it asked the percentage of female students after the addition."
P: " Why did you not write down the given information and the question?"
S26: "Because the text was not too long, it was already visible in the problem, I'd better do it directly".
P: “Then, what did you do to answer this question?"
S26: "The ratio is 5:4, so I just suppose that the number of male students is 5 and the female students are 4. Well, because the number of male students increased by 20%, it means 20% of 5 people is 1, so the male students are now 6 people. Then, the number of female students increased by 50%, meaning that there are 2 more people because 50% of 4 people is 2. So, now there are 6 female students. Because the total

number of students now is 12 people, to find the percentage I compare 6 with 12, and divided by 6 the result is 1/2. Then multiplied by 100%. So, there are 50% female students out of the total students after the new enrollment".

P: "What math concept did you use to answer this question?".

S26: "I used the concept of ratio".

The interview confirmed that S26 identified the problem and formulated it mentally, opting not to write down information due to the brevity of the text. S26 only remembered the information to solve the problem more efficiently. Furthermore, the formulation process was evident in the interview excerpt when S26 modeled the numbers in the ratio of many students. It demonstrates that S26 is creative in solving the problem, employing an unconventional strategy compared to others. The next process that S26 undertook was utilizing the concepts of ratio and proportion. S26 was able to interpret the process effectively. On the answer sheet, the process of interpreting the mathematical solution in the context of a real-world problem was not visible. However, it was confirmed through the interview that S26 could interpret the mathematical solution or conclusion in the context of the real world. Therefore, it can be concluded that S26, as a student with a high mathematical disposition was able to perform the entire mathematical literacy process proficiently in problem number 2 and answer the question correctly.

Students who have high mathematical dispositions can perform the mathematical literacy process well. S19 and S26 both have high mathematical dispositions. Based on the questionnaire results, S19 has a high interest in mathematics, understands and appreciates the role of mathematics in life, and has high flexibility when solving problems. It could be seen when S19 did not understand the concept of fractions, he could still find the correct solution by trying other alternatives, because flexibility is needed in solving mathematical literacy problems (Magalhães et al., 2020). While S19 used other alternative solutions when he did not understand a concept, S26 used other strategies because he was creative in solving problems. Based on the mathematical disposition questionnaire, S26 very often uses a variety of strategies in solving problems and is not fixated on one way. In addition to flexibility in solving problems, S19 is also very persistent in solving mathematical problems. Students' persistence and enthusiasm can be seen in S19's correct answers to two mathematical literacy questions. This finding is in accordance with the statement of (Amany et al., 2023), that student enthusiasm greatly affects students' problem-solving ability.

The results showed that mathematical disposition contributed to students' mathematical literacy skills. This statement is in line with the research findings of Lestari et al. (2019) which shows that students with high mathematical disposition have good mathematical literacy skills. The results revealed that students with high mathematical dispositions were able to perform the entire mathematical literacy process effectively. They can identify and formulate problems mathematically (formulate), use relevant mathematical concepts (employ), and interpret results in a real-world context (interpret). This is in line with the results of Kurniasari's (2019) research, that students with high mathematical disposition can perform the mathematical literacy process better than students with low or moderate mathematical disposition. Thus, students must have a high mathematical disposition in order to perform the mathematical literacy process well. Jablonka (2003) has also mentioned that to improve students' mathematical literacy skills, a positive disposition toward mathematics is needed. Students must have interest,

confidence, and perseverance as part of their mathematical disposition (Royster et al., 1999). In addition, students also need a learning environment that can encourage students' flexibility in thinking and confidence in doing mathematics (NCTM, 1991).

Mathematical Literacy Process of Students Who Have a Moderate Mathematical Disposition

Students with moderate mathematical dispositions are only able to do the process of formulating problems mathematically. Here is subject 25's answer for number 1.

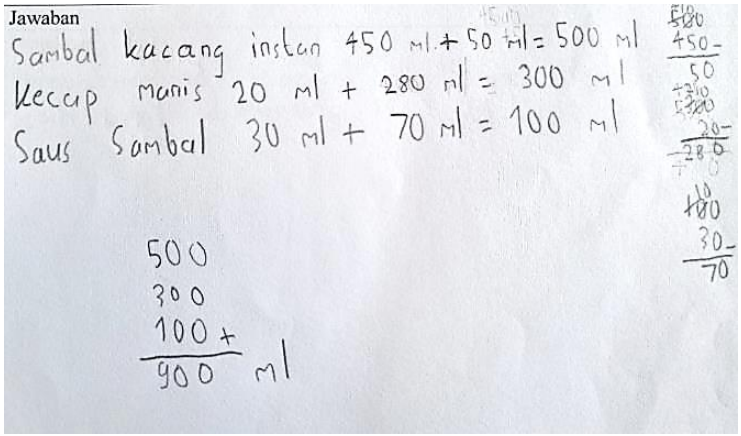

Figure 5. Mathematical literacy process by subject 25 for question number 1

Figure 5 shows that S25 answered the question incorrectly. S25 used simple addition instead of employing the correct concept of ratio and proportion. The figure above illustrates that S25 merely guessed which numbers, when added together, would produce 900. S25 did not employ any mathematical concepts of interpret the results. In the answer sheet above, there was no process of formulating the problem mathematically; instead, S25 was seen performing simple addition. To confirm this, the researcher interviewed with S25. Interview excerpt with S25

P: “I would like to ask about your answer to question number 1, what information was given and asked?"
S25: "The composition for making Batagor sauce, there are 450 ml peanut sauce, 20 ml sweet soy sauce, and 30 ml chili sauce. Then, what is asked is the composition of Batagor sauce for 900 ml".
P: "Why did you not write down the given information and the question?"
S25: "Because it's already on the table, just look at it".
P: "Then, what did you do to answer this question?"
S25: "I just guessed ma'am, right 500 + 300 + 100 is 900".
P: "Why don't you use the ratio?".
S25: "Yes, I should use the ratio, but I've forgotten that material, I don't even understand the concept of ratio, so I just guessed".

The interviex revealed that S25 identified the problem bbut did not apply any mathematical concepts. S25 did not write down the known and asked information because the information was already listed in the table. S25 relied solely on trial-and error addition

without using mathematical concepts. When S25 found the answer, He did not interpret the results in the real world. In conclusion, S25 with a moderate mathematical disposition, could only formulate problems but did not answer the question correctly.

Students with moderate dispositions can idedntify problems but struggle to apply mathematical concepts (Farida, 2015). However, they have difficulty in finding relevant mathematical concepts (employ) to solve the problem. Thus, the visible process is only simple calculations such as addition, and using trial and error strategies. Trial-and-error is a common stratgey when students do not recognize patterns or formulas (Meryansumayeka et al., 2021; Reys et al., 2008). While students with moderate dispositions can formulate problems, they struggle to apply concepts and interpret results in real-world context.

Mathematical Literacy Process Of Students With Low Mathematical Disposition

The mathematical literacy process carried out by students with low mathematical dispositions did not differ from the mathematical literacy process carried out by students with moderate mathematical dispositions. They only performed the process of formulating the problem mathematically and conducting simple calculations. Students with low or moderate mathematical dispositions were unable to answer the questions correctly. There were even students who did not attempt to answer the questions at all.

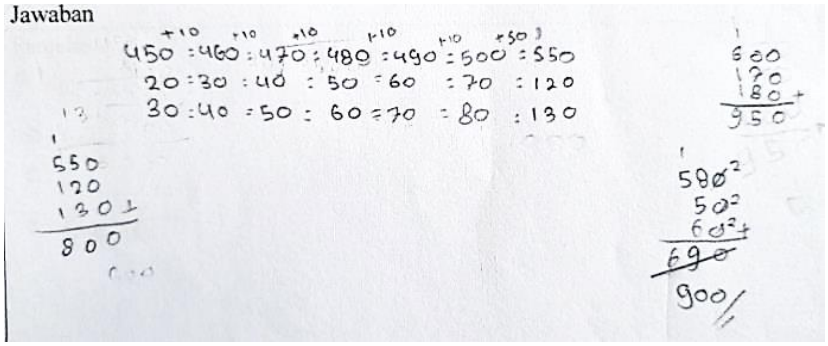

Figure 6. Mathematical literacy process by subject 14 for question number 1

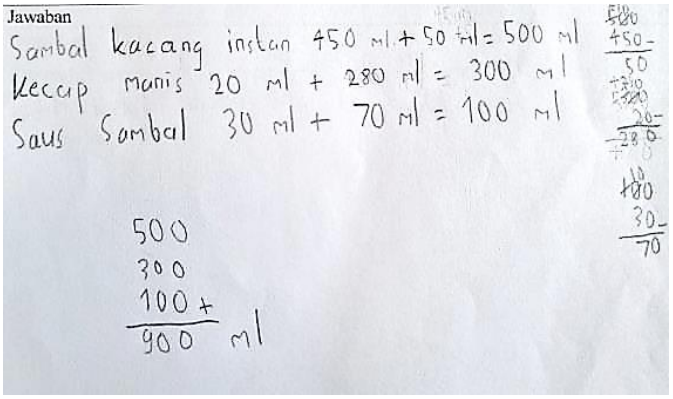

Figure 7. Mathematical literacy process subject 21 for question number 1

Based on figure 6, it can be observed that subject 14 (S14) could not answer the question correctly. S14 only performed a simple addition process to solve the problem

and merely guessed what numbers, when added together, would produce 900. Thus, S14 could not perform the process of employing concepts, and there were no sentences indicating S14's interpretation of the results. Based on the interview results, it was found that S14 carried out the process of formulating the problem mathematically, where S14 was able to identify information that could be used to solve the problem using mathematics.

Figure 7 shows subject 21 (S21) answerd correctly but did not show any solution steps, making it difficult to analyze his process. During the interview, S21 struggled to communicate, leaving his mathematical literacy process unclear. S21 also did not attempt question 2. Subject 17 (S17) left both questions unanswered. In the interview, S17 revealed confusion about which concepts to apply and struggled to understand the problem text, even after multiple readings. According to the mathematical disposition questionaire, S17 showed a lack of interest, persistance, and cconfidence in solving mathematical problems and did not value mathematics as much as other subjects.

Students with low mathematical dispositions can only formulate problems and perform basic calculations. Jailani et al. (2020) noted that such students often stop at problem formulation. They also tend to guess answers without using mathematical concepts, as observed in students with moderate dispositions. Satriani et al. (2023) found that these students cannot choose appropriate problem-solving strategies. This lack of understanding stems from ontogenic barriers, where students do not grasp fundamental concepts like ratio and proportion (Wahyuningrum et al., 2019).

One of the reasons why students struggle with mathematical literacy questions is their inability to comprehend the information and the instructions provided in the questions. According to Polya's problem-solving steps, students are required to understand the problem before devising a plan (Polya, 1988). When students fail to understand the problem, they find it challenging to formulate the problem mathematically. Therefore, poor reading comprehension hinders students from translating mathematical texts into equations (Duru & Koklu, 2011). To address this issue, teachers need to implement reading strategies to enhance students' understanding of mathematical problems. Strategies such as rereading, close reading, summarizing, and note-taking can assist students in comprehending what they read (Fang & Chapman, 2020).

Based on the results of the data analysis, several important factors may be involved in students' mathematical disposition that affect students' mathematical literacy skills. Students with high mathematical dispositions show creativity and flexibility in finding strategies for solving problems. As stated by Munafiah et al. (2021), students who have high mathematical dispositions are more flexible in using various strategies and approaches to solving math problems. Although the aspects encompassed in mathematical disposition are significant, students' difficulties in fraction operations indicate a lack of understanding of fundamental concepts. This is because mathematical literacy prioritizes understanding basic mathematical concepts to facilitate their representation both orally and in writing (McCabe, 2001). Students with high mathematical dispositions show high motivation and interest in mathematics, as significant motivation to achieve learning objectives positively influences students' mathematical literacy (Molina-Muñoz et al., 2023), while students with low mathematical dispositions show disinterest and difficulty in solving mathematical problems. This is in line with the results of research (Hutajulu et al., 2019), that learning motivation has a

positive and significant relationship with students' mathematical disposition. Students with low mathematical dispositions show low self-confidence and negative attitudes towards mathematics. Students with low mathematical dispositions tend to give up more easily in dealing with complex math problems (Lin & ChunTai, 2016).

Students' mathematical dispositions need to be identified early, and students with low mathematical dispositions need a more intensive approach to increase their motivation to learn. Teaching should focus on knowledge of basic mathematical concepts and problem-solving strategies. Many studies have found that Problem-Based Learning can improve students' mathematical literacy skills (Fery et al., 2017; Junianto & Wijaya, 2019; Maslihah et al., 2021; Priyonggo et al., 2021; Sari et al., 2017). Mathematics learning programs must include elements of the benefits of mathematics in everyday life, in culture, and in other sciences. Ethnomathematics in mathematical literacy can help students understand the role of mathematics in culture, and improve students' mathematical literacy skills (Agusdianita et al., 2021; Yuliana et al., 2022) because ethnomathematics and mathematical literacy are two things that can help a person understand mathematics in the real world (Wedege, 2010). Applying ethnomathematics in problem-based learning will greatly help develop students' mathematical literacy skills, positive attitudes, and appreciation of mathematics.

Study Limitations

This research was conducted with a case study approach on grade VII students in one school, so the results may not be fully generalizable to a wider population. The findings of this study are more descriptive of students' mathematical literacy process in the context of the school studied and may not reflect conditions in other schools with different backgrounds, student characteristics, and learning methods.

This study only selected three subjects with high, medium, and low dispositions, each of which only covered a particular category of mathematical disposition. It limits the understanding of more complex variations in mathematical disposition, as well as the influence of other factors that may appear in students with different dispositional characteristics.

Interviews explore students' thought processes, but the quality of interview data can be affected by the level of understanding and honesty of students in providing answers, as well as their ability to express their thought processes. It has the potential to create bias in the interpretation of students' mathematical literacy process.

▪ CONCLUSION

This study shows that mathematical disposition has a great contribution to students' mathematical literacy skills. Students with high mathematical dispositions can solve mathematical literacy problems effectively, exhibiting proficient mathematical literacy skills, as evidenced by the process of formulating problems mathematically, employing mathematical concepts, and interpreting results into real-world contexts. In contrast, students with moderate and low mathematical dispositions faced challenges in applying relevant mathematical concepts and were only able to identify important information that could be utilized to solve problems using mathematics. This is due to a lack of understanding of the basic concepts of ratio and proportion material, which can eventually lead to students forgetting all the material. Factors such as motivation, interest,

confidence, and attitude toward mathematics play an important role in shaping students' mathematical disposition, which, in turn, affects their mathematical literacy skills. To improve students' mathematical literacy skills, educators need to focus on developing students' mathematical dispositions. This involves increasing students' motivation to learn, interest in mathematics, and self-confidence, as well as ensuring they understand basic mathematical concepts and problem-solving strategies.

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