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ANALYSIS OF STUDENTS' MATHEMATICAL LITERACY ABILITY IN SOLVING PISA-ORIENTED QUESTIONS CONTENT CHANGE AND RELATIONSHIP JUDGING FROM SELF-EFFICACY

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ABSTRACT
Study This aims to analyze the connections between the ability o f literacy mathematical students to finish questions on PISA Change and relationships, which are oriented on content and levels of efficiency. Study This uses design study descriptive qualitative. The sample for this research consisted of three class VIII B students at SMPN 3 Colomadu, Karanganyar Regency. The three subjects were selected based on the results of responses to the questionnaire and PISA questions, taking into account their level of self-efficacy, which was divided into low, medium, and high. The research instrument consisted of a questionnaire regarding student self-efficacy and PISA questions related to Change and Relationship content. After analyzing the questionnaire and students' answers, they interviewed the three subjects. The research results show that students' mathematical literacy skills in solving questions oriented towards changes in PISA content and their interrelationships require improvement. The level of students' self-efficacy in solving mathematics literacy problems is classified as moderate, and there is a significant positive relationship between mathematics literacy abilities and students' self-efficacy.
Keywords: Self-Efficacy, Change and Relationship, Mathematical Literacy, PISA Questions

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PRELIMINARY

Mathematics skills are critical in increasing understanding of science today. Mathematical literacy refers to a person's ability to understand, apply situations, and analyze mathematical information in various situations (OECD, 2019b). These skills are critical for individuals to succeed in life and careers in modern times. One part of mathematical literacy is understanding changes and relationships between variables, essential to mastering (OECD, 2019a). Mastery of mathematical literacy is now a must for every student. With these abilities, students can use mathematics to solve problems. However, currently, there are still many students who consider mathematics to be a subject that is difficult to understand and complete. As a result, interest in introducing and understanding mathematical literacy has decreased (Husna & Munandar, 2022).

Students are not only required to have numeracy skills but also to be able to apply problem-solving in the context of globalization (Masfufah & Afriansyah, 2021). In the current era of globalization, students in Indonesia must be able to compete with students from various countries. Various international tests are often used as indicators to evaluate the extent of our students' abilities in facing global challenges (Johnson, 2018). Mathematical literacy is an individual student's ability to think mathematically and formulate and interpret mathematics to solve problems in everyday life. It includes concepts, procedures, facts, and tools to explain, predict, and describe phenomena. This helps students understand the role of mathematics in the modern world, which requires constructive, involved, and reflective evaluation and decision-making according to the needs of the 21st century (OECD, 2022).

PISA (*Program for International Student Assessment*) is an international exam that measures the level of mathematical literacy of students around the world. PISA is an international program that covers science, mathematics, and reading to evaluate the knowledge of 15-year-old students regarding their ability to solve problems in everyday life. One of the PISA assessment indicators in mathematics is mathematical literacy skills, which involve students' ability to apply, interpret, and explain everyday problem-solving processes using mathematical concepts. This ability is essential to measure students' success and confidence in understanding mathematical concepts and their applications (Hakiki & Wijayanti, 2021).

The results of the PISA Program show that the mathematical literacy abilities of Indonesian students are still far below average compared to other countries (OECD, 2018). According to the 2018 PISA study, Indonesia is ranked 73rd out of 79 countries or 6th from the bottom, scoring 379 on the mathematical literacy test (OECD, 2019b). Students tend to rely on the examples given by the teacher when working on questions, so they experience difficulties when the questions do not match the examples, which ultimately affects students' self-confidence in solving questions (Junika et al., 2020). The PISA program covers four mathematical contents: change and relationships, space and shape, number, uncertainty, and data. There are also six levels of ability, with the international average score for mathematical literacy being at level 3 with a score of 500, while the average score for Indonesian students' mathematical literacy ability is at level 1 with a score of 379 (Amelia et al., 2020). The condition of low PISA performance in Indonesia is a call to find solutions that can increase PISA scores. One solution is to give students

practice questions similar to the characteristics of PISA questions so that they become familiar with the types of questions tested in PISA (Mansur, 2018).

Self-efficacy refers to students' problem-solving confidence (Rokhmatillah et al., 2019). A high level of *self-efficacy can increase students' motivation and effort in learning, improving their academic achievement.* This is an individual's belief in their ability to carry out various tasks, produce results, organize themselves, achieve goals, and carry out the actions needed to master specific skills (Utama et al., 2023). One of the goals is to consolidate students' understanding of the subject matter so that they can apply it appropriately and effectively in overcoming daily challenges without hesitation (Junedi, 2018).

According to Bandura, as mentioned in (Marasabessy, 2020), there are three dimensions of *self-efficacy*: 1) The *Magnitude dimension* is related to the level of difficulty of the task that a person believes can be completed. When individuals face problems or tasks with a particular difficulty level, *self-efficacy* will vary between easy, medium, and complex tasks, according to their perception of their ability to meet the behavioral demands required at each difficulty level. 2) The *Strength dimension* is related to the level of strength or weakness of an individual's belief in their abilities. Individuals with solid *self-efficacy* regarding their abilities tend to be unyielding and persistent in improving their efforts, even when faced with obstacles. 3) The *Generality dimension* relates to how widely individuals can carry out various tasks. In overcoming or solving problems or tasks, some individuals have beliefs limited to specific activities or situations. In contrast, others have beliefs that expand across various activities or situations.

In solving problems, students with low levels of *self-efficacy* tend to avoid questions that are considered problematic. They can feel discouraged and reluctant to solve the problem without trying first. They also often feel afraid to ask questions and are always doubtful about the answers they give. On the other hand, students with high *self-efficacy* tend to solve problems actively and carefully. They quickly identify wrong strategies, can solve more problems, and are willing to retry unsuccessful tasks (Yamin et al., 2022).

The link between mathematical literacy and *self-efficacy* is the belief in one's ability to solve problems (Ananda & Wandini, 2022). Mathematical literacy is one of the critical factors of self-efficacy (Geraldine & Wijayanti, 2022). Students' mathematical literacy and *self-efficacy* are essential in their ability to analyze appropriately and solve problems when facing challenges involving mathematical literacy skills and *self-efficacy*, which can ultimately improve student learning outcomes (Ananda & Wandini, 2022). One approach

to improving learning models in the 21st century is increasing students' mathematical literacy and *self-efficacy* (Nugroho, 2021). To increase mathematical literacy, it is also essential to increase students' *self-efficacy* (Safrida et al., 2023).

Based on the explanation above, researchers are interested in exploring this problem to assess the mathematical literacy abilities of class VIII students at SMPN 3 Colomadu. This research makes a new contribution to the field of mathematics education. One of the main differences between this research and previous research is the research context. Previous research tends to focus on various local or national contexts, while this research focuses on the specific content of PISA questions, namely change and relationships (OECD, 2016). This context is crucial because it allows a deeper analysis of how students understand and apply the concepts of change and relationships in mathematics.

Next, the difference lies in problem-solving. Previous research only assessed general mathematical literacy skills without considering specific problem-solving aspects in the context of change and relationships. This research, however, seeks to identify how students solve specific problems related to change and relationships, providing more detailed insight into the strategies and difficulties students face (OECD, 2018).

Another difference is in the content of the PISA questions used. Previous research may have used PISA questions that cover a variety of content, while this study specifically chose questions with change and relationship content. The selection of this content is based on relevance and difficulty level, which can more accurately describe students' mathematical literacy abilities in the specified context (Stacey, 2015).

The place of research is also a differentiating factor. Previous research may have been conducted in various locations, while this research was conducted in specific locations chosen to reflect specific student conditions and characteristics. This allows for a more focused and relevant generalization of the results to the local context (Schoenfeld, 2016).

METHODS

This research uses a qualitative research method with a descriptive approach, which aims to provide an in-depth picture of students' mathematical literacy abilities in the context of PISA questions with the content "change and relationships" and its relationship with self-efficacy. The research sample consisted of 30 students in class VIII B at SMP Negeri 3 Colomadu, Karanganyar Regency. The selection of class B was based on the

results of random class division, which showed that students in class B had better abilities than those in other classes. This is important to ensure that the selected sample has sufficient competence to provide relevant and accurate data (Merriam & Tisdell, 2016)

Research subject criteria include students participating in contextual mathematics learning relevant to the tested material. This approach ensures that students have the basic knowledge to complete tests based on PISA questions. Thus, students are expected to be able to use the knowledge they have acquired in learning to answer the questions given effectively and efficiently (Merriam, 2015). Considering that the assessment of mathematical literacy in PISA is aimed at students aged 15, the subjects of this research were students aged 15 (Geraldine & Wijayanti, 2022).

Research subjects were selected based on their self-efficacy scores and divided into three categories: low, medium, and high. Students with low self-efficacy are identified as those who have low self-confidence in solving mathematical literacy problems. Students with moderate self-efficacy are considered to have a moderate level of self-confidence. In contrast, students with high self-efficacy are believed to have high self-confidence in solving mathematics problems (Zimmerman, 2016). Subject selection also considers good communication skills, as conveyed by information from the teacher, so that the data obtained aligns with expectations (Hinton et al., 2016). Determining the subject in qualitative research is based on describing the conditions or facts that occur to the subject. Therefore, the number of subjects in qualitative research is flexible; in some cases, one subject may be sufficient. The focus in determining the number of subjects is not on representation but on the depth of information that can be obtained from the selected subjects (Merriam & Tisdell, 2016).

As a data collection tool in this research, a research instrument was used, which consisted of several parts, including a *self-efficacy questionnaire*, two PISA questions focused on *change and relationship content* covering four different contexts, as well as an interview guide (Woolley, 2014). Technical triangulation is a research approach that combines several techniques or methods to obtain comprehensive and valid data. This research used technical triangulation by combining several methods: a self-efficacy questionnaire, PISA questions on change and relationship content, and the interview stage. First, a self-efficacy questionnaire was used to measure students' level of self-confidence in solving mathematical literacy problems. This provides information regarding students' perceptions of their abilities in solving mathematical problems (Zimmerman, 2016).

Second, giving PISA questions with change and relationships content provides data about students' mathematical literacy abilities in solving mathematical problems that require an understanding of change and relationships. This allows researchers to measure students' abilities to apply specific mathematical concepts in relevant contexts (OECD, 2016). Third, the interview stage deepens the researchers' understanding of students' mathematical literacy abilities in solving problems. Interviews allow researchers to gain deeper insight into students' thinking processes, strategies, and obstacles or difficulties in solving mathematics problems (Merriam, 2015).

By combining these three techniques, research can produce more comprehensive and valid data regarding students' mathematical literacy abilities and the factors that influence these abilities.

Table 1. *Self-Efficacy* Indicators

Dimensions	Indicators
Magnitude (Level of Difficulty)	1. Students' confidence in being able to complete complex tasks 2. Students' confidence in being able to achieve goals 3. Students' confidence in being able to overcome challenges
Strength (Strength)	1. Students' confidence in being able to overcome challenges or obstacles in learning 2. Students' confidence in being able to survive in difficult situations 3. Commit to achieving success.
Generality (Generalization)	1. Ability to deal with a variety of different situations 2. Students' ability to adapt to changes in learning 3. Ability to achieve diverse goals

The mathematical literacy test consists of 2 PISA questions with *Change and Relationship content.* In the context of *change and relationship* content, the PISA questions have been adapted to language and conditions relevant to the Indonesian context without changing the essence of the PISA questions (Woolfolk, 2020).

Table 2. Mathematical Literacy Indicators (OECD, 2019a)

No.	Indicators	Information
1.	Communications	They are reading, writing, outlining, interpreting, and formulating problems.
2.	Mathematizing	We are transforming real-world problems into mathematical form, interpreting mathematical results and models about the initial problem.
3.	Representation	Present problems in graphs, tables, diagrams, and pictures.

No.	Indicators	Information
4.	Reasoning and argument	Logical thinking process so that conclusions emerge, examine, and provide justification for statements or solutions to problems.
5.	Devising strategies for solving problems	Ability to design strategic plans and implementation processes to use mathematics as problem-solving.
6.	Using symbolic, formal, technical language and operations	Use of formal language and symbolic, technical operations involving understanding, interpreting, manipulating, and using symbolic expressions in a mathematical context (including arithmetic expressions and operations)
7.	Using mathematical tools	Knowing how to use mathematical tools to help solve mathematical problems.

Table 3. Mathematical Literacy Indicators (OECD, 2019a)

No.	Mathematical Literacy Indicators	question
1.	Understanding Mathematical Concepts	What information can be obtained from the questions?
2.	Problem-solving skills	How do we find the pattern to solve this problem?
3.	Critical Thinking	Once you find the pattern, how do you solve this problem?
4.	Mathematical Communication Skills	What are your obstacles in solving this problem?
5.	Confidence	How confident are you in solving this problem?

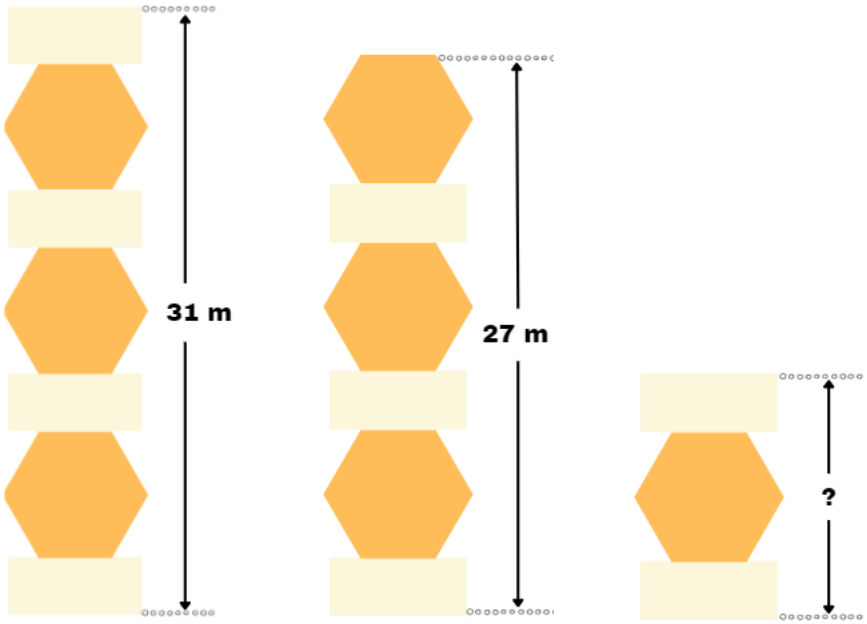
This research used comprehensive data analysis techniques to analyze students' mathematical literacy skills. The following is a clear explanation of the data analysis techniques used:

1. Data Description: The initial step in data analysis is data description, where the data obtained from the PISA model test relating to penguins and towers will be explained in detail. It includes descriptive statistics such as mean, median, and standard deviation to understand the general characteristics of the data.
2. Question Item Analysis: Question item analysis is carried out after the data is obtained from the PISA model test. This involves examining each question individually to understand its difficulty level, discrimination, and validity. In this way, it is possible to see how well each question measures students' mathematical literacy abilities.
3. Error Analysis: Next, student errors in answering test questions are analyzed. This involves identifying common error patterns and factors that may cause them, such as difficulty understanding concepts, calculation errors, or a lack of solution strategies.

4. Comparative Analysis: PISA model test result data can also be analyzed by comparing student scores with national or international average scores from similar tests. This allows researchers to assess the extent to which students' mathematical literacy abilities are measured in a broader context.
5. Correlation Analysis: Finally, a correlation analysis was conducted between mathematics literacy test scores and other variables such as student self-efficacy. This aims to determine whether a significant relationship exists between mathematical literacy abilities and other factors influencing test results.

Using this data analysis technique, researchers can deeply understand students' mathematical literacy abilities and the factors influencing their test results.

1. Below are three towers of different heights, each composed of two shapes: a hexagon and a rectangle.



What is the height of the shortest tower?

2. Penguin

Animal photographer Jean Baptiste went on a year-long expedition and took many photos of penguins and their chicks. Penguins reproduce yearly, so Jean Baptiste wants to know the number of penguins in one population for the following years.

Jean Baptiste assumed the following population numbers for penguins:

a. At the beginning of the year, a population consisted of 20,000 penguins (10,000 pairs)
b. Every year, a pair of penguins produces one chick in the summer
c. By the end of the year, 20% of all penguins (adults and chicks) will die
d. Children born in the summer at the beginning of the year will grow up and produce children the following summer

Question:

Based on the assumptions above, using the formula:

First year: $P_1 = 20.000 \times (1{,}5 \times 0{,}8)$

Determine the fourth-year formula and calculate the total number of penguins, P, after four years!

RESULT AND DISCUSSION

This research collected information through questionnaires, written tests, and interview sessions. Then, a description was carried out regarding junior high school students' mathematical literacy abilities in solving questions that focused on *Change and Relationship content* by the PISA orientation in terms of *self-efficacy*.

The results of the *self-efficacy questionnaire* conducted in class VIII B of SMP Negeri 3 Colomadu are depicted in Table 3.

Table 4. *Self-Efficacy* Questionnaire Results

Self-Efficacy	**Number of Students**
Tall	2
Currently	18

Self-Efficacy	Number of Students
Low	10

The following is an analysis of the results of the three subjects investigated in the mathematical literacy test using PISA questions on *Change and Relationship content*.

1. Analysis of Low-Ability Subjects

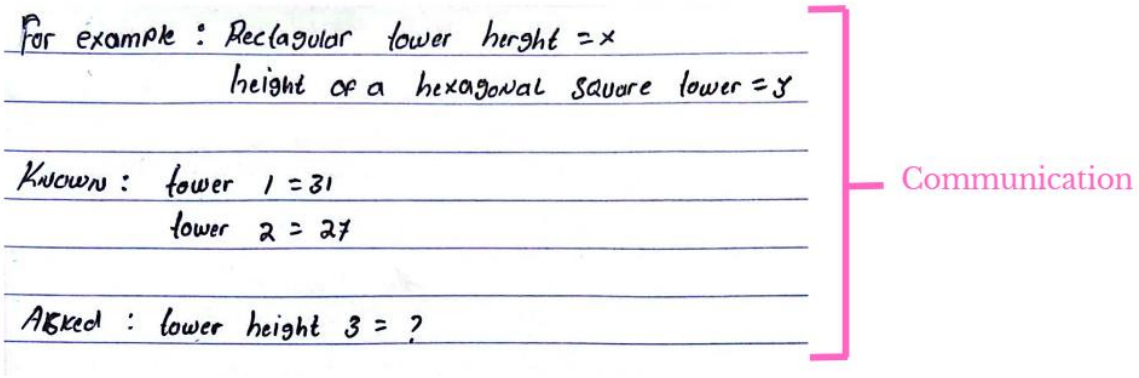


Figure 1. Subject 1 Question Number 1

Figure 1 shows that subject 1 needs a greater understanding of question number 1. Subject 1 can only identify the information needed and can only solve mathematical literacy problems on the *communication indicator*. Subject 1 has difficulty solving problems.

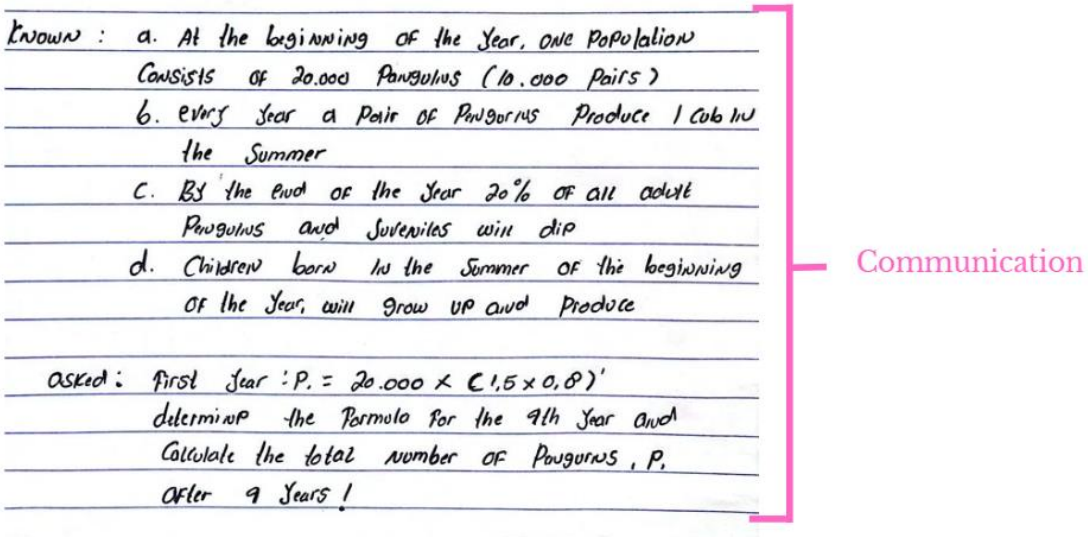


Figure 2. Subject 1 Question Number 2

Figure 2 shows that subject one needs to understand question number 2 better. Subject 1 can only identify the information needed and can only solve mathematical

literacy problems on the *communication indicators*. Subject 1 has difficulty solving problems.

The following are the results of the interview session between the researcher and subject 1. The researcher used the code "P" for the questions asked, while the answers from subject one were coded "S1".

P: What information can be obtained from the questions?

S1: Question number 1 is about towers, and question number 2 is about penguins

P: What are your obstacles in solving this problem?

S1: I am confused in solving the questions and understanding the solutions to questions number 1 and number 2

The interaction results with subject one show that the subject only meets one indicator of mathematical literacy and has limitations in reasoning and giving appropriate reasons. When answering questions, subject 1 showed a good understanding of the information given and the questions asked, but the subject needed clarification in solving the problem.

2. Analysis of Subjects with Moderate Abilities

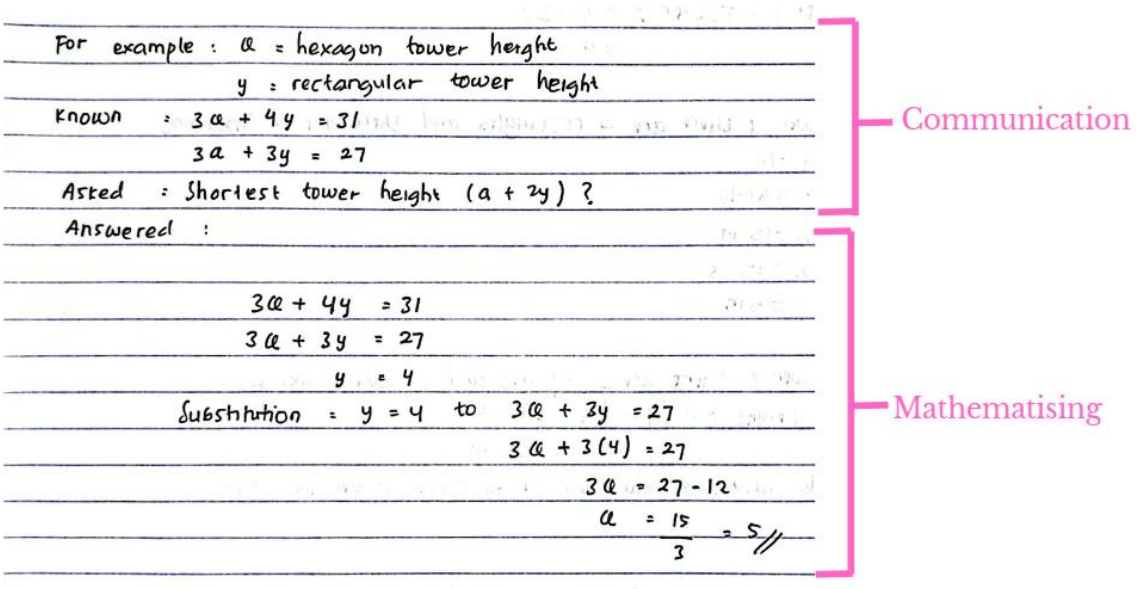


Figure 3. Subject 2 Question Number 1

From Figure 3, subject 2 has a good understanding of question number 1. Subject 2 can identify the information needed and convert it into mathematical sentences, but subject 2 can only solve mathematical literacy problems by focusing on *communication* and *mathematical indicators*. Subject 2 has limitations in designing

strategies to find solutions using the substitution method and providing appropriate arguments, as seen in the *mathematizing indicator* where subject 2 still needs to complete the answer. However, when using operations and symbolic language, subject two can solve problems using symbols such as the letters x and y and apply addition and multiplication operations correctly, as seen in Figure 3.

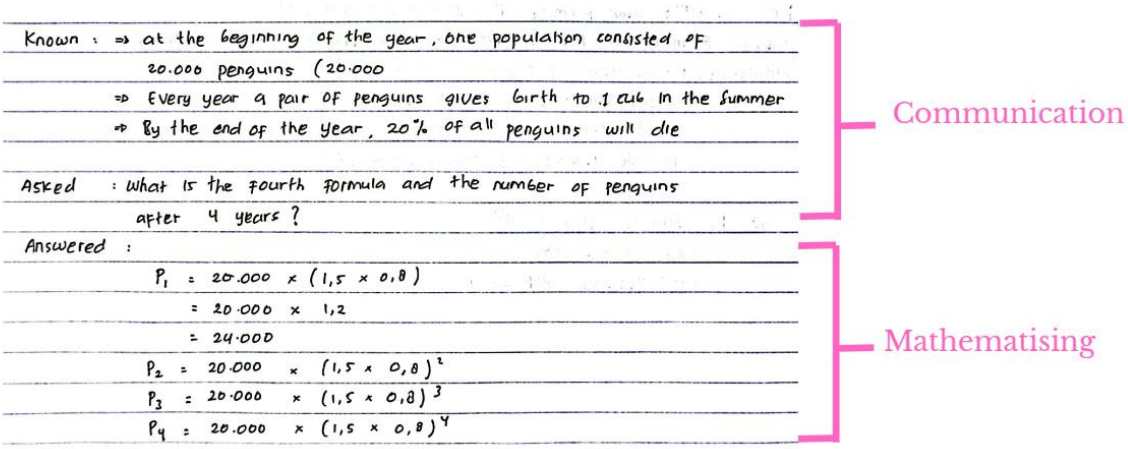


Figure 4. Subject 2 Question Number 2

From Figure 4, subject 2 has a good understanding of question number 2. Subject 2 can identify the information needed and determine an accurate formula for the first year to the 4th year. However, subject two could only solve mathematical literacy problems on the *communication* and *mathematizing indicators*. It can be seen that subject two experiences limitations in designing strategies to find calculation solutions and provide appropriate arguments, as illustrated in the *mathematizing indicator*, where subject two still needs to complete the answer.

The following are the results of the interview session between the researcher and subject 2. The researcher used the code "P" for the questions, while the answers from subject two were coded "S2".

P: What information can be obtained from the questions?

S2: Question 1 asked about the height of the third tower, while question 2 was about the formula and number of penguins for year 4.

P: How do we find the pattern to solve this problem?

S2: I solved question 1 by eliminating Towertowers 1 and 2. Since question 2 already asked for a formula in the first year, I just had to continue the formula for the following year.

P: Once you find the pattern, how do you solve this problem?

S2: Question number 1 was substituted, but I needed clarification after finding the results x and y. For question number 2, I could only continue the formula until the fourth year.

P: What are your obstacles in solving this problem?

S2: I was confused in solving the questions because I did not understand SPLDV and multiplication with powers like that

P: How confident are you in solving this problem?

S2: I need to learn how to solve this problem.

The interview results with subject 2 indicated that the subject needed to reach the standard in mathematical literacy indicators and had limitations in reasoning and providing appropriate reasons. However, when answering questions, subject 2 showed a good understanding of the information provided and the questions asked, could convert it into mathematical form, and explained the strategies used in solving the problem.

3. High-Ability Subject Analysis

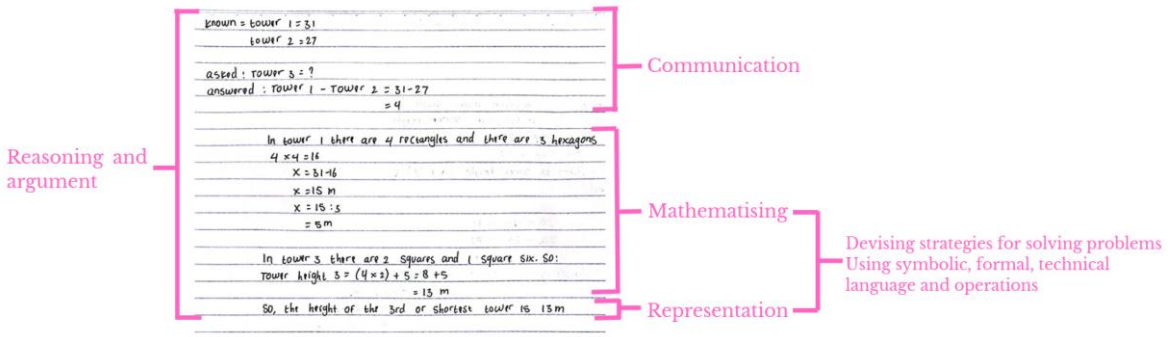


Figure 5. Subject 3 Question Number 1

Figure 5 shows that subject 3 has good mastery of all indicators of mathematical literacy in question number 1. Regarding *communication* and *mathematizing*, subject three can identify the required information and convert it into mathematical sentences with appropriate reasoning. Subject 3 can also design strategies to find solutions with substitutions and provide appropriate arguments. In using operations and symbolic language, subject three can solve problems using symbols such as the letter x and apply addition and multiplication operations correctly, as seen in Figure 5. Subject 3 can also reason and provide reasons appropriate to his work's results.

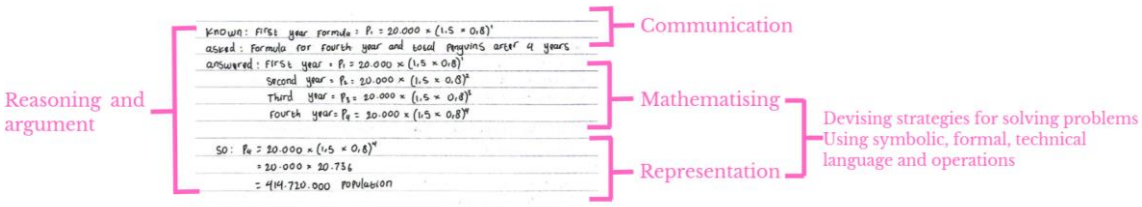


Figure 6. Subject 3 Question Number 2

Figure 6 shows that subject three is proficient in all aspects of mathematical literacy in question number 2. Subject 3 can recognize the necessary information and determine accurate formulas for the first to the fourth year. He can also plan strategies to find solutions and apply addition and multiplication operations correctly, as depicted in Figure 6. Subject 3 is also able to reason and provide reasons, even though he does not express conclusions from the results of his work.

The following are the results of the interview session between the researcher and subject 2. The researcher used the code "P" for the questions, while the answers of the three subjects were coded "S3".

P: What information can be obtained from the questions?

S3: Question 1 asked about the tower's height, while question 2 asked about the formula and the number of penguins.

P: How do we find the pattern to solve this problem?

S3: I solved question number 1 by reasoning because it could be reasoned with, while question number 2 already asked for a formula in the first year, so I just had to continue the formula for the following year.

P: Once you find the pattern, how do you solve this problem?

S3: Question number 1 is substituted, and question number 2 calculates the exponents and multiplies them to find the result.

P: What are your obstacles in solving this problem?

S3: Too lazy to read questions

P: How confident are you in solving this problem?

S3: I am confident in my ability to solve the question because I understand what is being asked and can answer it.

The interview results with subject 3 showed that the subject could meet the mathematical literacy indicators and reasons and give appropriate reasons. When answering questions, subject 3 shows a good understanding of the known and asked

material, can convert it into mathematical form, explains the strategies used in solving problems, uses language and mathematical operations correctly, and can draw conclusions from the results of his work.

The following are the theoretical links and opportunities obtained from the research results:

1. Self-Efficacy Theory (Bandura): The research results show that students' self-efficacy significantly influences their mathematical literacy abilities. Students with high self-efficacy tend to perform better in mathematics problems. These findings suggest the importance of developing students' self-efficacy in learning mathematics. Opportunities to develop student self-efficacy can be achieved through providing constructive feedback, strengthening self-confidence, and providing challenges appropriate to the student's ability level.
2. Development of Conceptual Understanding (Vygotsky): The finding that a good understanding of the material and strong reasoning skills are fundamental in solving mathematics problems reflects the importance of developing conceptual understanding and reasoning skills in mathematics learning. These findings imply the importance of designing learning experiences that enable students to build a deep understanding of mathematical concepts and develop strong reasoning skills through providing challenging assignments and encouraging reflection.
3. Learning Strategy Development (Constructivism): The results of this research also provide practical implications for mathematics teachers in designing learning strategies that suit student needs. Mathematics teachers can use a student-centered learning approach, facilitate active and collaborative learning, and provide relevant and varied challenges according to students' ability levels.
4. Education Policy: This research's implications are also relevant for policymakers who want to improve mathematics learning approaches in schools. Policymakers must consider providing adequate resources, quality teacher training, and ongoing support to ensure that practical mathematics learning approaches can be implemented at all levels of education.

By understanding the relationship between theory and opportunities obtained from this research, more effective efforts will be made to improve mathematics learning in schools and students' mathematical literacy skills.

CONCLUSION

The research method used in this research is qualitative with a descriptive approach. The research sample consisted of 30 students in class VIII B at SMP Negeri 3 Colomadu, Karanganyar Regency. This research uses PISA model test instruments related to content and change and a self-efficacy questionnaire to measure students' level of self-confidence in solving mathematical literacy problems. Interviews were conducted with research subjects to understand students' mathematical literacy abilities better.

The results of the research show that students' mathematical literacy abilities still need improvement, with students with low ability only being able to meet one indicator of mathematical literacy, students with moderate ability only being able to meet two indicators, and students with high comprehension being able to meet all indicators of mathematical literacy. In addition, it was found that the level of students' self-efficacy related to their ability to solve mathematics literacy problems was classified as moderate, and there was a significant positive relationship between mathematics literacy abilities and students' self-efficacy.

Based on these findings, it is recommended that students should improve their mathematical literacy skills by focusing on content changes and relationships. Teachers must pay special attention to students with low and moderate abilities by developing conceptual understanding and reasoning skills. It is also essential to increase students' self-efficacy in solving mathematical problems through a supportive learning approach and providing constructive criticism.

The future challenge is for researchers to describe mathematical literacy abilities by considering other mathematical literacy contexts or by reviewing the difficulty level of the questions used by referring to various literature and paying attention to various relevant contexts. This will help develop a deeper understanding of the factors influencing students' mathematical literacy skills and how best to improve them.

Thus, this conclusion emphasizes the need for joint efforts from educators, researchers, and other stakeholders to continue to develop effective and supportive learning strategies to improve students' mathematical literacy skills.

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