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Identification Of Students' Errors In Solving Mathematical Literacy Problems On Quadratic Function Material

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Abstract— Mathematical literacy is an essential skill to master; however, the results of the PISA survey participated in by Indonesia indicate the low mathematical literacy skills of Indonesian students. To address the low level of students' literacy skills, it is necessary to identify the types of errors students make in solving mathematical literacy problems. This study aimed to analyze the errors made by junior high school students in solving mathematical literacy problems on linear function material. The research design used was a descriptive qualitative approach by selecting tree Grade VIII junior high school students from one of the schools in Bengkulu City as the subjects. The data were obtained using a mathematical literacy test instrument on linear function material given to the students. The description of errors was derived from analyzing the students' work in solving problems within the process domain of mathematical literacy. Based on the analysis of students' answers, several errors were found when they solved mathematical literacy problems in the processes of formulating, employing, and interpreting. The students' errors in solving problems on quadratic function material included, at the formulate stage, failing to write the given and required information from the problem, and incompletely translating the problem into mathematical expressions. At the employ stage, students made errors in the solution steps, such as calculation mistakes and errors in algebraic operations. At the interpret stage, students made mistakes in formulating the solution into a proper conclusion.

Keywords— Error Identification, Mathematical Literacy, Problem Solving, Quadratic Function.

I. INTRODUCTION

In the era of the Industrial Revolution 4.0, the ability that must be possessed by every individual, especially students, is the ability to respond quickly to managing the evolving information. This ability is referred to as literacy. Students must understand and master 21st-century literacy, which emphasizes data-based knowledge, technology, and humanism, not merely the skills of reading, writing, and arithmetic [1]. Literacy is defined as a person's ability to read, write, speak, calculate and solve problems at the level of proficiency required by work, family and society [2]. In mathematics learning, students are not only required to have numeracy skills but also the ability to relate and apply relevant mathematical concepts, procedures and facts to solve problems faced in everyday life [3]. Such mathematical ability is referred to as mathematical literacy.

According to the Organization for Economic Cooperation and Development (OECD), literacy ability is the individual's capacity to reason, formulate, solve, and interpret everyday life problems mathematically [4]. It includes the ability to reason mathematically and to use concepts, procedures, and facts as tools to describe, explain, and predict a phenomenon or event. Mathematical literacy can help individuals recognize the role of mathematics in the real world and serve as a basis for reasoning and decision-making needed by society. Mathematical literacy serves to clarify the contributions and benefits of mathematics while utilizing it to make good decisions as productive, sensitive and critical citizens [5]. Mathematics is so integrated in today's life that

individuals cannot fully understand the information around them without a basic knowledge of mathematical concepts. The ability of mathematical literacy enables students to develop skills and confidence in thinking numerically and spatially, as well as to analyze everyday situations critically and solve problems.

In fact, students' ability in solving mathematical literacy problems is still low. The mathematical literacy of junior high school students in public schools in Kupang is generally in the low category, both in terms of content domain and process domain [6]. Students' errors in mathematical literacy include difficulties in understanding and transforming mathematical problems, hesitation, inaccuracy, and failure to perform calculations [7]. Other errors include misunderstanding word problems correctly, errors in converting word problems into mathematical sentences, and errors in writing the final answer [8]. As well as student errors in using data, misconceptions, understanding and transforming mathematical problems, language interpretation errors, technical errors and errors in providing conclusions [9]. These facts indicate students' errors in solving mathematical literacy problems. Therefore, appropriate solutions are needed to address these issues. One of the solutions that can be applied is identifying the difficulties experienced by students in solving mathematical literacy problems.

In solving mathematical literacy problems, three mathematical literacy processes have been established to assess students' abilities. The following are the mathematical literacy processes that serve as ability indicators according to PISA 2018 [10]; 1) formulating situations mathematically, 2) employing mathematical concepts, facts, procedures, and reasoning, and 3) interpreting, applying, and evaluating mathematical outcomes. The content used in this study is quadratic functions, which are one of the Grade IX junior high school materials. Many students experienced errors in understanding the concepts, principles, skills, and calculations related to quadratic functions when solving problems. Based on the research results, it was found that students still made many errors in solving quadratic function problems. Students made errors in solving quadratic equations, which are also related to quadratic functions, due to their lack of understanding of quadratic equations, such as not following the instructions in the questions, having difficulty in recognizing quadratic equations, and mishandling signs. In line with the study by W. Islamiyah *et.al* [11], students still made many errors in solving quadratic function problems, including conceptual, procedural, and technical errors.

In general, mathematical errors refer to mistakes that can be observed in students' work in solving mathematical problems. Therefore, it is necessary to conduct an analysis of the errors made by students because by analyzing these errors, teachers can identify the difficulties students face in understanding certain mathematical concepts. This enables teachers to design more effective teaching strategies, develop more appropriate curricula, and formulate suitable remediation programs. From this explanation, it can be concluded that the purpose of this study is to identify students' errors in solving mathematical literacy problems by examining the mathematical literacy processes and the abilities within them, so that in the future, students and teachers can improve the learning process related to mathematical literacy.

II. RESEARCH METHOD

The type of research design used was descriptive qualitative, with the aim of describing the errors made by students in solving problems related to three-dimensional shapes, viewed from the level of mathematical literacy ability of junior high school students. The stages of this research included: instrument development, feasibility testing, and the implementation of the mathematical literacy test. This research was conducted at one of the junior high schools in Bengkulu City during the odd semester of the 2023/2024 academic year. The research subjects were selected using purposive sampling. The criteria for the subjects were students who had studied the quadratic function material. The process of selecting subjects was based on the results of the mathematical literacy test using a predetermined scoring scale. The subjects of this study involved 3 students in class VIII, which were selected including one student with high test result criteria, one student with medium test result criteria, and one student with low test result criteria. The three subjects were labeled differently to make it easier to understand the research results presented in Table 2 below.

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TABLE I. SELECTED SUBJECT LABELS AND CATEGORIES

No.	Subject Label	Test Result Criteria
1.	S1	High
2.	S2	Medium
3.	S3	Low

The data collection technique in this study was obtained through testing. The test consisted of three essay questions on quadratic function material to measure mathematical literacy, developed by referring to the process domains in mathematical literacy, namely formulating (formulate), employing (employ), and interpreting (interpret). The following is the test item specification grid for the mathematical literacy instrument used.

TABLE II. SPECIFICATION GRID OF THE MATHEMATICAL LITERACY ABILITY TEST ITEMS

Process Domain Ability	Indicator	Item Numbers	Question Type
Formulating (Formulate)	Identifying facts and formulating problems mathematically	1, 2, and 3	Essay
Employing (Employ)	Strategies used in the problem-solving stage		
	Performing calculations based on specific rules or formulas		
Interpreting (Interpret)	Drawing conclusions based on observed data		

III. RESEARCH RESULTS AND DISCUSSION

Based on the results of the analysis of students' errors, each student had different types of errors. This study revealed several findings of students' errors in solving mathematical literacy problems based on the mathematical processes, namely formulating (formulate), employing (employ), and interpreting (interpret).

1. Formulating Process

The results of the analysis on each problem of the three subjects, where subjects with high criteria have been able to complete the indicators of formulating correctly, subjects with medium criteria in some problems have been able to formulate but in some problems there are errors in the solution. While subjects with low criteria still experience errors in completing the formulation indicators. Formulating situations mathematically was measured using problems related to area, height, and time measurement. The formulation process of subject S3 was shown in answering question number 2 as follows:

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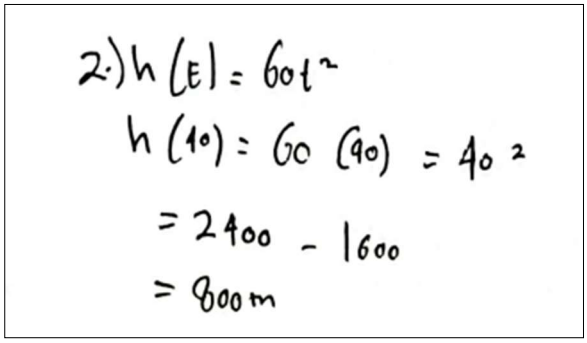

Fig. 1.*S3's Test Result for Question Number 2*

Based on Figure 1, S3 had difficulty in determining the part being asked in the question, resulting in an inaccurate solution. This includes errors in capturing information and identifying the known and asked parts of the problem. Among the six subjects, all were found to have made errors in understanding question number two. Similarly, the answers to question number three from subjects S2 and S3 can be seen in Figure 2 and Figure 3.

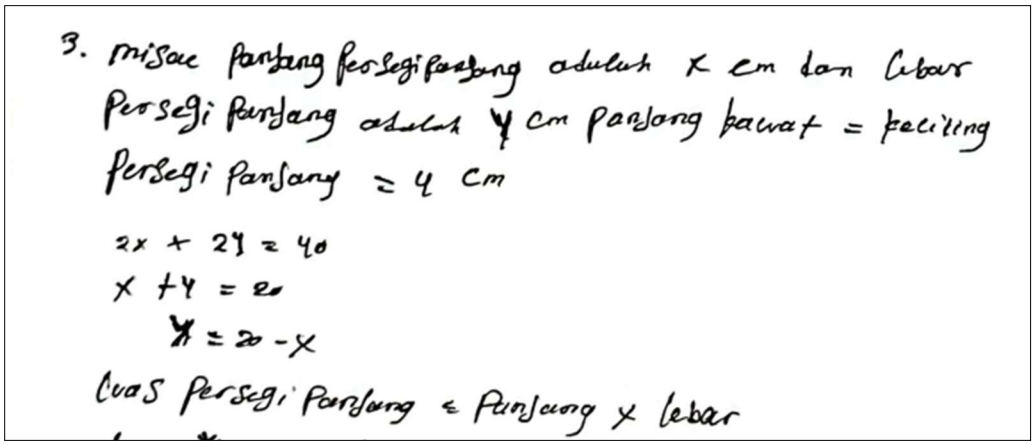

Fig. 2.*S3's Test Result for Question Number 3*

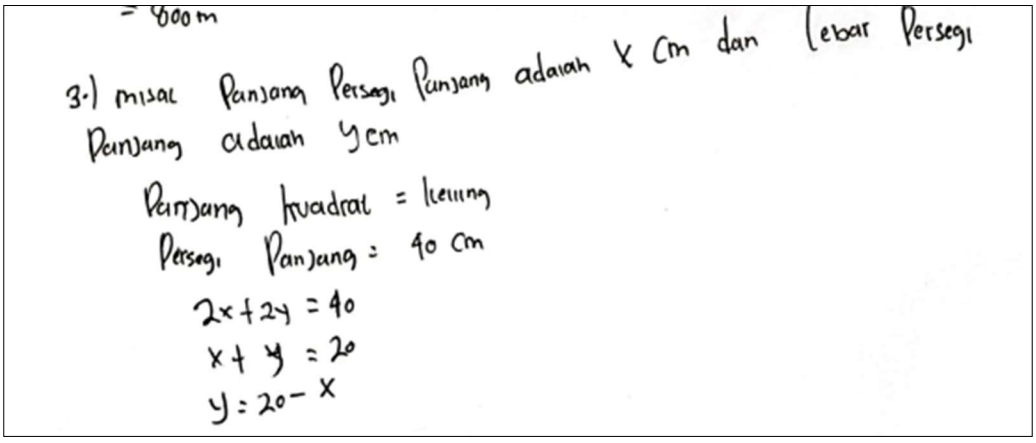

Fig. 3.*S2's Test Result for Question Number 3*

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For question number three, the answers of each subject were almost the same in terms of the mathematical modeling they wrote. For example, S2 and S3 constructed a mathematical model first before writing the assumptions. However, the mathematical model constructed by the subjects was still inaccurate. In mathematical literacy, the main components are understanding the problem and transforming it into a mathematical form, followed by the ability to use the encountered problem to create a solution [12]. Difficulties in literacy skills are primarily indicated in the problem comprehension process. This is in accordance with research conducted by Azizah *et al*., [13], errors in understanding problems are caused by students not being able to link their prior knowledge to solve problems.

2. *Employing Process*

Based on the analysis results for each question, the three subjects were less able to accurately complete the employing indicator. All three subjects tended to answer the questions simply and quickly, which led to the improper use of appropriate problem-solving steps. An example of a solution that illustrates the employing process in solving question number 3 by subject S2 can be seen in Figure 4.

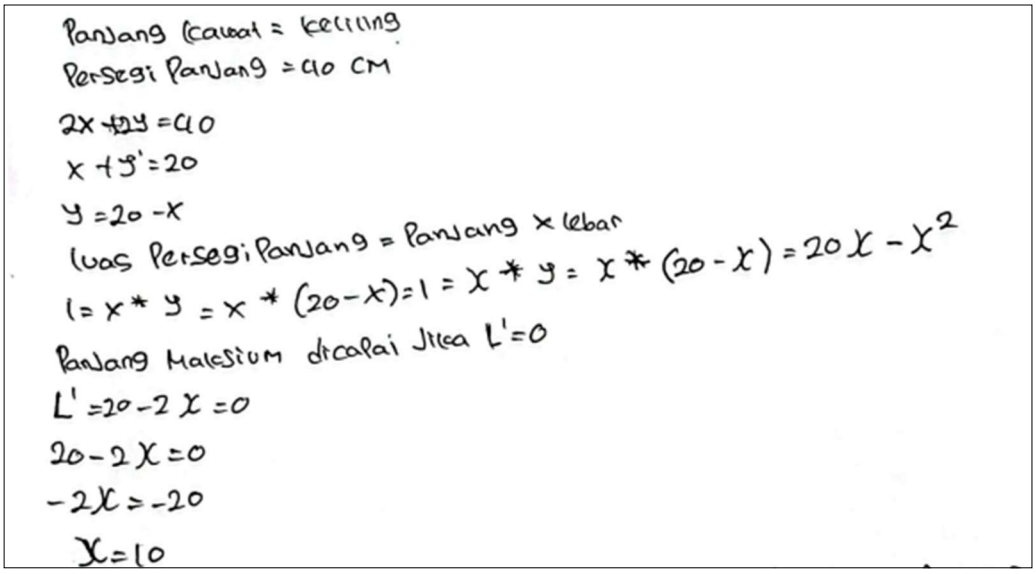

Fig. 4.*S2's Test Result for Question Number 3*

The answer shows that subject S2 wrote and explained the solution steps in an unstructured manner by substituting important variables into the formula that had already been written. Then, the subject used incorrect mathematical solution steps. In addition to low problem comprehension, errors in the mathematical literacy process are also caused by misunderstandings of solution strategies. Based on the study by Musafir and Susiswo [14], several factors contribute to errors in using strategies for problem-solving, namely misconceptions, procedural errors, technical errors, and writing errors. Students with moderate mathematics ability are less able to solve problems in accordance with the objectives [13]. Subjects with low mathematical literacy skills experienced misconceptions or misunderstandings regarding a problem and the solution that should be applied. Therefore, it can be concluded that in the formulation process, some subjects are less able to fulfill, calculate, and design the strategy indicators by planning the solution steps.

3. *Mathematical Interpreting Process*

The analysis results for question number one showed that S1 wrote a conclusion and interpreted the solution but was not precise. In contrast, S2 and S3 only wrote the results they had obtained without providing a rational explanation. In question number two, some subjects were able to accurately complete the mathematical interpreting indicator. In question number three, S2 and S3 did not write a conclusion or interpret the solution. S1 was able to evaluate the mathematical solution; however, the

statement made was inaccurate. The answers of subjects who made errors in the mathematical interpretation process can be seen in Figure 5.

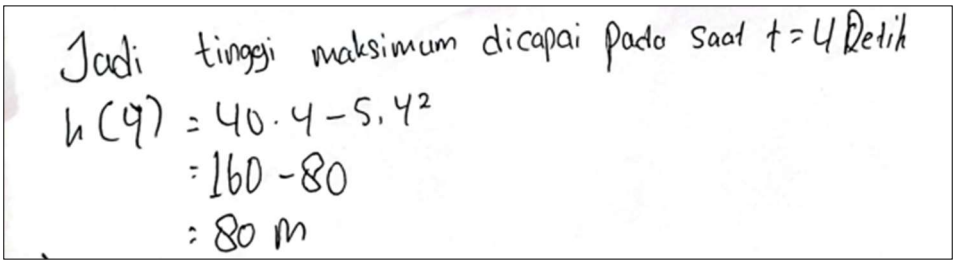

Fig. 5.*S3's Test Result for Question Number 1*

There are still some errors in the conclusion drawing step. This is categorized as a technical error because the subject made mistakes in the final stage of drawing conclusions [14]. This is in line with research conducted by Sri Indriati Hasanah *et al.,* [15] that the subject was unable to provide reasons or evidence for the correctness of the solution and was unable to draw conclusions.

IV. CONCLUSION

Based on the discussion presented, it can be concluded that this study showed the subjects were not yet able to fulfill all the indicators of mathematical literacy in the mathematical processes, namely formulating (formulate), employing (employ), and interpreting (interpret). The errors made by the students were distributed across the formulate, employ, and interpret processes. At the formulate stage, students did not write the given and required information from the problem, and did not completely formulate the problem into mathematical expressions, this error occurred in subjects who had low criteria. Then, at the employ stage, students made errors in the solution steps, such as miscalculations and mistakes in algebraic operations, this error occurs in subjects who have high, medium, and low criteria. The most frequent errors occurred at the interpret stage, where students made mistakes in formulating the solution into a conclusion, this error occurs in subjects who have medium and low criteria.

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REFERENCES

[1] R. Begum and H. A. Liton, "Needs and Demands Of 21st Century Learning Skills: A Reflective International Journal of English Language, Literature and Translation Studies (IJELR) Needs And Demands of 21 St Century Learning Skills : A Reflective," *Int. J. english Lang. Lit. Transl. Stud.*, vol. 5, no. 1, pp. 222–232, 2018.

[2] Ratna Rintaningrum, "Explaining the Important Contribution of Reading Literacy to the Country's Generations: Indonesian's Perspectives," *Int. J. Innov. Creat. Chang.*, vol. 5, no. 3, pp. 936–953, 2019, [Online]. Available: https://www.ijicc.net/images/Vol_5_Iss_3/Part_2_2020/5310_Ratna_2019_E_R.pdf

[3] W. Wardono, N. Karomah Dwidayati, J. Dalu Bintang, K. Komodo, K. Manggarai Barat, and N. Tenggara Timur, "Mathematical Literacy Ability Viewed by Students' Mathematical Habits of Mind Using Quick on the Draw Model With SPUR Approach," *Ujmer*, vol. 10, no. 1, pp. 40–49, 2021, [Online]. Available: http://journal.unnes.ac.id/sju/index.php/ujmer

[4] OECD, "Pisa 2022 Mathematics Framework (Draft)," no. November 2018, 2018, [Online]. Available: https://pisa2022-maths.oecd.org/files/PISA 2022 Mathematics Framework Draft.pdf

[5] W. A. Rahmawati, B. Usodo, and L. Fitriana, "Mathematical Literacy of Students Who Have High Mathematical Disposition in Solving PISA-Like Mathematics Problems," *Proc. Int. Conf. Math. Math. Educ. (I-CMME 2021)*, vol. 597, pp. 281–287, 2021, doi: 10.2991/assehr.k.211122.039.

[6] D. W. Fointuna, A. H. Kaluge, and A. J. Fernandez, "An analysis of mathematical literacy of state junior high school students in Kupang," *J. Phys. Conf. Ser.*, vol. 1422, no. 1, 2020, doi: 10.1088/1742-6596/1422/1/012025.

[7] N. Ratnaningsih and E. Hidayat, "Error analysis and its causal factors in solving mathematical literacy problems in terms of habits of mind," *J. Phys. Conf. Ser.*, vol. 1764, no. 1, 2021, doi: 10.1088/1742-6596/1764/1/012104.

[8] N. Nuryati, S. S. Purwaningsih, and E. Habinuddin, "Analysis of errors in solving mathematical literacy analysis problems using newman," *Int. J. Trends Math. Educ. Res.*, vol. 5, no. 3, pp. 299–305, 2022, doi: 10.33122/ijtmer.v5i3.164.

[9] A. Dwita and H. Retnawati, "Students' errors in solving mathematical problems," *AIP Conf. Proc.*, vol. 2575, no. December, 2022, doi: 10.1063/5.0107794.

[10] OECD, *PISA 2018 Results (Volume I)*, vol. I. 2019. doi: 10.1787/5f07c754-en.

[11] W. Islamiyah, D. Suryadi, and M. A. Gulvara, "Student Errors on Quadratic Function Story Problems Based on The Nolting Theory," *Edumatica J. Pendidik. Mat.*, vol. 13, no. 03, pp. 191–202, 2023, doi: 10.22437/edumatica.v13i03.26254.

[12] N. R. Aini, S. Syafril, N. Netriwati, A. Pahrudin, T. Rahayu, and V. Puspasari, "Problem-Based Learning for Critical Thinking Skills in Mathematics," *J. Phys. Conf. Ser.*, vol. 1155, no. 1, 2019, doi: 10.1088/1742-6596/1155/1/012026.

[13] N. N. Azizah, S. Susiswo, and S. Sisworo, "Analytical Thinking Process of Students in Solving Mathematical Problems of Quadratic Functions," *AKSIOMA J. Progr. Stud. Pendidik. Mat.*, vol. 10, no. 1, p. 328, 2021, doi: 10.24127/ajpm.v10i1.3440.

[14] R. R. Musafir and S. Susiswo, "The strategies and errors of high school students' in solving logarithmic inequalities," *AIP Conf. Proc.*, vol. 2330, no. March, 2021, doi: 10.1063/5.0043439.

[15] S. I. Hasanah, C. F. Tafrilyanto, and Y. Aini, "Mathematical Reasoning: The characteristics of students' mathematical abilities in problem solving," *J. Phys. Conf. Ser.*, vol. 1188, no. 1, 2019, doi: 10.1088/1742-6596/1188/1/012057.