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## The Numeracy Literacy Process of Fifth-Grade Elementary School Students in Solving Word Problems

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### ABSTRACT

This study investigates the numeracy literacy skills of fifth-grade elementary students in comprehending and solving mathematical word problems. Conducted from February to April 2025, the research adopts a qualitative approach using a case study method. Four students participated two from SD Telkom Makassar and two from SD Islam Athirah Makassar. Data were gathered through classroom observations, in-depth interviews, and a literacy-based numeracy test. The test focused on four key competencies: generalizing, conjecturing, justifying, and convincing. To enhance the credibility of the results, data triangulation was applied across sources, methods, and time. The objective of this research is to understand how students engage in mathematical reasoning and identify the obstacles they face in progressing through the stages of problem-solving. The findings show that students who successfully solved problems were those who could interpret the context, recognize patterns, and explain their reasoning clearly. However, several participants were only able to conjecture or identify patterns but struggled to justify or convince others of their solutions. In conclusion, this study emphasizes the importance of developing instructional strategies that focus not only on producing correct answers but also on enhancing students' reasoning processes. A key contribution of this research is its in-depth analysis of students' thinking errors, particularly in structuring operations and maintaining accuracy in word problem responses.

## 1. Introduction

Numeracy literacy is a fundamental competence that plays a crucial role in 21st-century education. It encompasses the understanding and application of quantitative information in everyday life. According to the OECD (2020), numeracy literacy involves not only the ability to perform calculations but also the capacity to analyze and use data in various contexts. This skill is increasingly important given the growing complexity of the modern world, where students are expected to make data-driven decisions. Literacy and numeracy are essential basic competencies,

especially at the primary school level. Literacy extends beyond reading and writing; it includes the ability to comprehend and utilize information for critical thinking, problem-solving, and decision-making (OECD, 2020). Numeracy refers to the use of mathematical concepts in daily life, such as calculating, measuring, and analyzing data (Zubaidah, 2018). These competencies serve as a foundation for students to develop holistically across different aspects of life. However, the literacy and numeracy achievement of Indonesian students remains relatively low. According to the 2018 PISA report, Indonesia scored below the OECD average, with a literacy score of 371 and a numeracy score of 379 (OECD, 2019). These figures indicate an urgent need to improve literacy and numeracy education in primary schools.

To assess students' achievement of core competencies, the Indonesian government introduced the Minimum Competency Assessment (Asesmen Kompetensi Minimum or AKM) and the computer-Based National Assessment (Asesmen Nasional Berbasis Komputer or ANBK). As stated by the Ministry of Education and Culture (Kemendikbud, 2020), the AKM evaluates how well students understand and apply literacy and numeracy concepts in real-life situations. These assessments are expected to help schools identify students' learning gaps and improve educational quality. One key aspect of the AKM is numeracy literacy, which reflects students' ability to perform calculations, reason logically, and think critically to solve problems (Firdaus et al., 2019). Mathematics instruction is currently guided by several core standards: mathematical problem solving, communication, reasoning, connections, and representation. Students with strong numeracy literacy skills can apply mathematical knowledge to real-life challenges (Firdaus et al., 2019). As such, mathematics education should emphasize the development of mathematical literacy, defined as the ability to formulate, apply, and interpret mathematics in diverse contexts (Stacey, 2011).

Numeracy literacy includes mathematical reasoning and the use of procedures, facts, and tools to describe, explain, and predict phenomena. Yet, many students still struggle to relate mathematical concepts to real-life situations. This issue highlights the need for deeper research on students' thought processes when solving problems, especially in connecting abstract concepts with practical applications. Such insights are essential to inform teaching strategies that enhance students' accuracy, structured problem-solving, and the contextual application of mathematical ideas. A study by Mukhlis et al. (2024) showed that mathematical thinking literacy begins with problem understanding, then representing the problem in a simplified form (specialization), followed by identifying patterns (generalization). Similarly, Syamsuddin et al. (2019, 2024), Al-Ghofiqi et al. (2019), and Dewantara et al. (2015) emphasized that numeracy literacy combines problem-solving with the interpretation of real-world mathematical contexts. Furthermore, Hardianti and Zulkardi (2019), as well as Ojose (2011), found that students with strong mathematical literacy are better at generalizing concepts and applying them across broader scenarios.

These findings reinforce that mathematical literacy involves more than correct answers. It requires deep conceptual understanding, the ability to apply ideas to

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real-world contexts, and logical, systematic reasoning. Therefore, supporting the development of mathematical thinking stages such as specialization, generalization, conjecturing, and convincing is essential to foster students' ability to effectively navigate and respond to various life challenges.

## **2. Methodology**

### ***Research Method***

This study adopts a qualitative research approach to investigate students' numeracy literacy processes in solving mathematical word problems. The use of qualitative methods is grounded in the nature and objectives of the research, which aim to gain a deep understanding of the cognitive processes, meanings, and individual strategies involved. The research design follows a case study approach, enabling an in-depth exploration of how students interpret, approach, and solve story-based mathematical problems.

### ***Research Instruments***

The researcher serves as the primary instrument in this study and is actively involved throughout the data collection process. This includes observing classroom learning activities, conducting semi-structured interviews with both students and teachers, and documenting students' written work. Direct engagement with participants ensures the collection of rich, detailed, and contextualized data.

### ***Research Subjects***

The subjects consist of four fifth-grade students selected purposively from two elementary schools in Makassar: SD Telkom and SD Islam Athirah. From each school, one student with high mathematical ability and one with moderate to low ability were chosen to ensure variation in performance levels. Additionally, fifth-grade teachers from both schools were included as supporting informants. The research was conducted over a two-month period (February–April 2025), with alternating site visits for observation and interviews.

### ***Data Collection Techniques***

Data were collected through multiple methods, including numeracy literacy tests, in-depth interviews, classroom observations, documentation of student work, and comprehension assessments. Students' numeracy literacy was evaluated based on four indicators: generalizing, conjecturing (estimating solutions), justifying (evaluating and verifying answers), and convincing (presenting logical validation of responses). To enhance data credibility, triangulation of sources and time was implemented.

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### Data Analysis Techniques

The analysis process involved several stages: initial data processing, coding, and categorization. Data sources included numeracy test results, interview transcripts, field notes, and documentation. Open coding was used to identify emerging categories and themes, while in vivo coding using participants' actual words was applied to preserve the authenticity of their perspectives. This approach ensures that findings are grounded in the participants' own expressions and experiences, thereby increasing the trustworthiness of the analysis.

### 3. Results and Discussion

This study aims to describe the numeracy literacy process of fifth-grade elementary school students in solving story problems. A case study was conducted involving two students from SD Telkom Makassar (students A and B) and two students from SD Islam Athirah Makassar (students C and D). Numeracy literacy encompasses mathematical reasoning as well as the application of mathematical concepts, procedures, facts, and tools to describe, explain, and predict phenomena. However, one of the challenges faced in mathematics learning is students' low ability to connect mathematical concepts with real-life situations, as observed in the implementation with fifth-grade students in both schools, shown in the students' worksheets as Figure 1 until Figure 4:

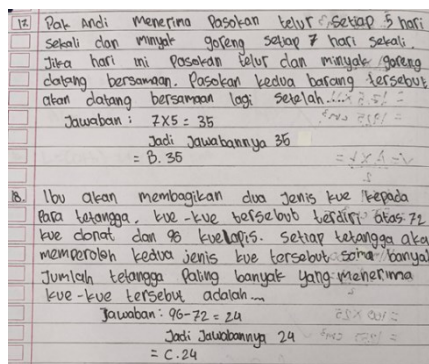


Figure 1 Student (A) Worksheet of SD Telkom Makassar

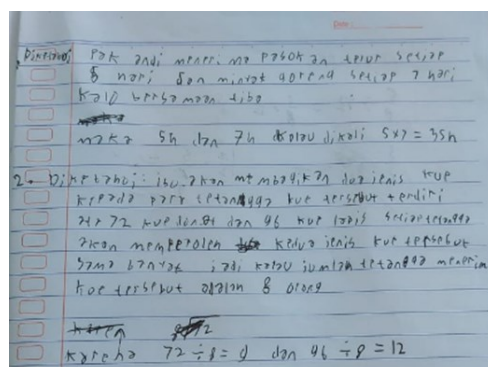


Figure 2 Student (B) Worksheet of SD Telkom Makassar

The worksheet from SD Telkom Makassar indicates that the student is developing numeracy literacy skills through solving math problems related to the Least Common Multiple (LCM) and Greatest Common Divisor (GCD). In the first problem, the student attempts to determine when two recurring events will coincide by applying the LCM concept. The student demonstrates understanding of how multiples of two numbers can be used to find simultaneous timing, but errors remain in the written calculation process that need to be corrected to become more systematic and accurate.

Meanwhile, in the second problem, the student applies the GCD concept to determine the maximum number of cake recipients with equal distribution. The student's mathematical thinking process in this problem reflects a basic understanding of division, but calculation errors and presentation mistakes are still present. These errors indicate that although the student understands the basic concept, they still need to improve accuracy in writing down the solution steps and presenting the answer correctly. The subsequent study conducted at SD Islam Athirah Makassar used the same problems, and the students' worksheets are presented as follows:

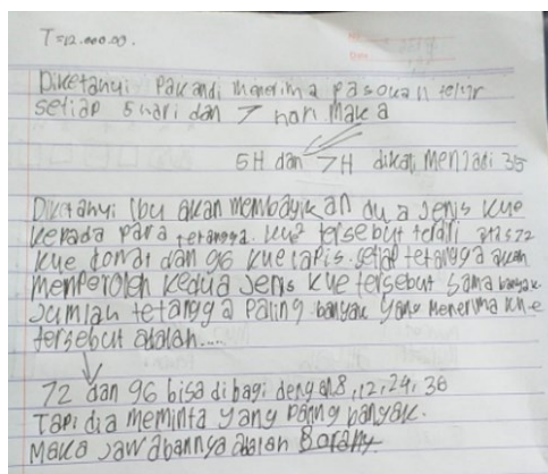


Figure 3 Student (C) Worksheet of SD Islam Athirah Makassar

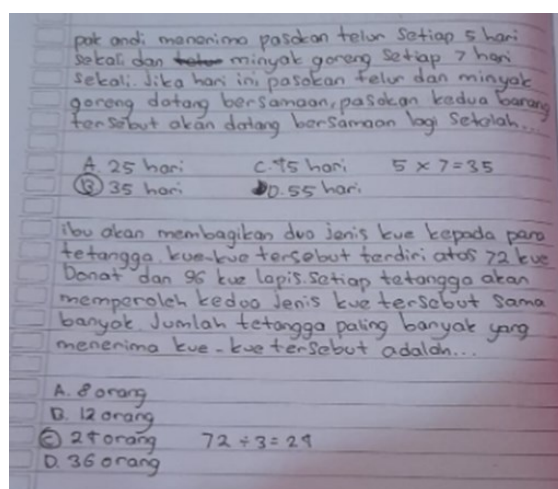


Figure 4 Student (D) Worksheet of SD Islam Athirah Makassar

The worksheet of the student from SD Islam Athirah shows that in the first problem, the student attempts to determine when two recurring events will happen simultaneously by applying the LCM concept. The student's thought process reflects understanding that multiples of two numbers can be used to find the simultaneous time. Although the selected answer, 35 days, is correct, there are still deficiencies in the answer presentation, such as less systematic calculation writing and unclear mathematical symbols.

In the second problem, the student applies the GCD concept to determine the maximum number of cake recipients with equal distribution. The student understands that the GCD of two numbers can be used to fairly divide the cakes among recipients. The answer given, 24 people, is appropriate according to the GCD concept. However, shortcomings remain in writing the calculation steps systematically, so the student's mathematical thinking process is not yet fully evident in a structured manner.

Based on the worksheets from SD Telkom Makassar and SD Islam Athirah Makassar, it appears that students' mathematical thinking processes in solving LCM and GCD problems still show some weaknesses, especially in calculation systematics and accuracy in writing answers. Although students understand the basic concepts of LCM to determine simultaneous event times and GCD for equal distribution, they still lack systematic presentation of the solution steps. This indicates that while students possess fairly good conceptual understanding, they struggle to present their answers in a structured and accurate manner. The findings can be summarized as in Table 1.

Table 1 Main Findings of this research

Student Code	School	Literacy Numeracy Ability	Explanation
1 (A)	SD Telkom Makassar	Medium	Able to generalize simple patterns but not yet strong in justification and reasoning.
2 (B)	SD Telkom Makassar	Low	Has difficulty distinguishing the use of LCM and GCD and struggles to conclude answers.
3 (C)	SD Islam Athirah Makassar	High	Able to conclude and convincingly support answers well, consistently using patterns.
4 (D)	SD Islam Athirah Makassar	Medium	Has skills in conjecturing and generalizing but is still weak in convincing.

Based on the results, Student C demonstrated the highest level of numeracy literacy, particularly in recognizing patterns, formulating conjectures, and presenting convincing justifications. This student was able to conclude that "if two activities occur simultaneously, the LCM is applied," indicating a strong conceptual understanding. In contrast, Student B encountered significant difficulties in recognizing mathematical patterns and distinguishing between the use of LCM and GCD, reflecting a limited grasp of fundamental concepts.

Students A and D showed emerging abilities in forming conjectures, though their understanding was not consistently grounded in accurate logic. At the justification stage, only Student C was able to articulate the reasoning behind mathematical choices using clear and consistent logic. Student D exhibited hesitation, while Students A and B typically presented only the final answers without supporting explanations.

Interview results further confirmed variations in students' numeracy literacy. Student A displayed partial understanding, able to associate LCM with simultaneous events but still confused when differentiating between LCM and GCD. When prompted to explain his reasoning, he relied on procedural calculation without clear justification. Student B showed even lower comprehension, frequently expressing uncertainty and relying on intuition rather than logical analysis.

In contrast, Student C demonstrated advanced mathematical reasoning and could explain and justify his solutions with confidence. This included using more than one strategy (e.g., listing multiples and prime factorization). Student D showed promise, particularly in identifying patterns, but lacked confidence when asked to justify or defend his reasoning. These findings reinforce that students' numeracy literacy is closely linked to their ability to think logically, structure mathematical reasoning, and communicate their understanding effectively. The observed differences across students underline the importance of strengthening the mathematical communication dimension in instructional practices.

The study confirms that fifth-grade students show varying degrees of numeracy literacy in solving LCM and GCD word problems. Students with strong conceptual foundations were better able to generalize patterns, formulate and justify conjectures, and present well-reasoned solutions. Conversely, students with weak conceptual understanding often struggled to connect story problems to the appropriate mathematical operations and failed to provide logical explanations.

According to Ramírez et al. (2022), mathematical thinking involves a cyclic process through which learners interpret symbolic relationships, reason, prove, generalize, and specialize in solving problems. Supporting this, Wulandari and Rahman (2021) found that students often jump into calculations without understanding the problem's context, resulting in erroneous solutions. These findings highlight the urgent need for structured teaching strategies that emphasize problem comprehension before solution attempts.

Consistent with Firdausy et al. (2023), this study supports the notion that numeracy literacy significantly contributes to students' problem-solving performance. Their findings showed that numeracy literacy accounted for 38.4% of variance in fifth-graders' ability to solve story problems. Siti and Budi (2022) further emphasized that when students fail to connect classroom mathematics to real-life applications, their motivation—and thereby their performance—declines.

Additional studies reinforce these findings. Al-Ghofiqi et al. (2019) emphasized that meaningful problems enhance students' mathematical thinking. Dewantara et

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al. (2015) and Hardianti & Zulkardi (2019) added that mathematical literacy is not only about solving problems but also interpreting mathematical ideas in real contexts. However, misconceptions remain a barrier. Pristiwanti and Yuhana (2023) found that errors in LCM and GCD problems often stem from poor conceptual understanding and lack of systematic reasoning. Research by Putri et al. (2023) and Murniati (2023) supports the use of contextual and problem-based learning approaches to enhance students' performance in LCM and GCD tasks. Alif et al. (2024) echoed these findings, highlighting the central role of logical thinking and conceptual mastery in fostering numeracy literacy.

This study contributes a novel focus on students' mathematical thinking errors, particularly in the systematization and accuracy of written responses. While previous research (e.g., Mukhlis et al., 2024) emphasized general mathematical literacy or its real-life application (e.g., Al-Ghofiqi et al., 2019; Dewantara et al., 2015), the current study uniquely identifies specific cognitive barriers students face when structuring and justifying their answers. Moreover, although generalization skills have been explored (Hardianti & Zulkardi, 2019; Ojose, 2011), this study draws attention to students' struggles in transitioning from conjecture to justification.

In conclusion, these findings underscore the need to enhance students' numeracy literacy through targeted instructional strategies, contextual learning environments, and opportunities for mathematical reasoning and communication. A strong conceptual base, coupled with structured and reflective practice, is essential in equipping students with the skills to solve real-life mathematical problems effectively.

#### **4. Conclusion**

This study shows that the numeracy literacy process of 5th-grade elementary students in solving story problems is strongly influenced by their ability to understand the problem context, recognize patterns, and construct as well as communicate mathematical reasoning logically. The numeracy literacy process, examined through the dimensions of generalizing, conjecturing, justifying, and convincing, reveals that not all students are able to fully complete all four stages. Many students stop at the stages of pattern recognition and making conjectures without being able to explain or justify their answers. This finding highlights the need for instructional interventions that focus not only on the final answers but also on students' mathematical thinking processes and argumentation skills.

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