

# Analysis of Junior High School Students' Numeracy Literacy with Various Levels of Mathematical Curiosity

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## Abstract

Numerical literacy is an essential competency in education, yet the results of the 2022 Programme for International Student Assessment (PISA) indicate that most Indonesian students still have low numerical literacy skills. One factor suspected to contribute to this issue is mathematical curiosity. This study aims to analyze students' numeracy literacy skills based on their levels of mathematical curiosity. A descriptive qualitative approach was employed, with research subjects selected through purposive sampling at a junior high school in Kolaka Regency, Southeast Sulawesi. Data were collected through a mathematical curiosity questionnaire and an open-ended numeracy literacy test. The data analysis process involved reduction, presentation, and conclusion drawing. The results indicate that students with a high level of mathematical curiosity exhibit better numeracy literacy skills than those with moderate or low curiosity. They can explore information in depth, recognize patterns, and apply appropriate strategies to solve problems. Students with moderate curiosity demonstrate a good understanding of numeracy but require further encouragement to present a more comprehensive problem-solving process. Meanwhile, students with low curiosity tend to be less engaged in problem exploration and in providing thorough solutions. These findings reinforce the significant role of curiosity in strengthening numeracy literacy.

**Keywords:** Learning strategies, Mathematical curiosity, Numeracy literacy, Problem-solving, Student engagement

## Abstrak

Literasi numerasi merupakan kompetensi esensial dalam pendidikan, tetapi hasil Programme for International Student Assessment (PISA) 2022 menunjukkan bahwa sebagian besar siswa Indonesia masih memiliki kemampuan literasi numerasi yang rendah. Salah satu faktor yang diduga berkontribusi terhadap kemampuan ini adalah rasa ingin tahu matematis. Penelitian ini bertujuan untuk menganalisis kemampuan literasi numerasi siswa berdasarkan tingkat rasa ingin tahu matematis. Pendekatan yang digunakan adalah kualitatif deskriptif dengan subjek penelitian yang dipilih melalui teknik purposive sampling di salah satu SMP di Kabupaten Kolaka, Sulawesi Tenggara. Pengumpulan data dilakukan melalui angket rasa ingin tahu matematis dan tes literasi numerasi berbasis soal uraian. Data dianalisis melalui tahapan reduksi, penyajian, dan penarikan kesimpulan. Hasil penelitian menunjukkan bahwa siswa dengan rasa ingin tahu tinggi memiliki kemampuan literasi numerasi yang lebih baik dibandingkan siswa dengan rasa ingin tahu sedang dan rendah. Mereka mampu mengeksplorasi informasi secara mendalam, memahami pola, serta menerapkan strategi yang tepat dalam menyelesaikan masalah. Siswa dengan rasa ingin tahu sedang menunjukkan pemahaman numerasi yang cukup baik, tetapi memerlukan dorongan lebih lanjut dalam menampilkan proses pengerjaan yang lengkap. Sementara itu, siswa dengan rasa ingin tahu rendah cenderung kurang terlibat dalam eksplorasi masalah dan penyelesaian soal secara menyeluruh. Hasil ini menegaskan bahwa rasa ingin tahu berperan penting dalam penguatan literasi numerasi.

**Kata kunci:** Strategi Pembelajaran, Rasa ingin tahu matematis, Literasi numerasi, Pemecahan masalah, Keterlibatan siswa

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## INTRODUCTION

Numeracy literacy is a fundamental skill that supports the ability to understand and apply mathematical concepts in various aspects of life. Numeracy literacy has become an essential

competency in global education systems, reflecting an individual's ability to understand, apply, and interpret mathematical concepts and symbols in various real-life contexts (OECD, 2019). According to the 2022 Programme for International Student Assessment (PISA) results, 82% of Indonesian students possess mathematical competence below Level 2. Although Indonesia improved by five ranks in numeracy literacy, its average score of 366 decreased by 13 points compared to the previous assessment and remained 106 points below the global average (OECD, 2023). This situation is a significant concern, as numeracy literacy is a crucial skill in the modern era. Mastery of numeracy literacy enables individuals to acquire, describe, analyze, utilize, and communicate mathematical symbols effectively for problem-solving, making judgments, and decision-making (Sari et al., 2021; Rakhmawati & Mustadi, 2021; Perdana & Suswandari, 2021).

Several studies have indicated that Indonesian students' numeracy literacy remains relatively low compared to that of students in other countries (Ambarwati & Kurniasih, 2021). Numeracy literacy is generally defined as the ability to solve problems and analyze data (Widyati et al., 2023; Syifauzakia, 2020). Winarni et al. (2021) further elaborate that numeracy literacy encompasses the ability to interpret, acquire, utilize, and communicate mathematical symbols to address problems. One of the key factors contributing to this low level of numeracy literacy is the lack of student familiarity with numeracy-based problems, leading to difficulties in problem-solving (Anggriani et al., 2024; Fiangga et al., 2019).

Mathematical curiosity plays a fundamental role in the learning process and is a crucial factor in the development of students' understanding of mathematics. Mustari (2017) defines curiosity as an attitude and action that drive individuals to gain deeper and broader knowledge about something they study, observe, or hear. Silmi & Kusmarni (2017) add that curiosity is a natural emotion that motivates individuals to further investigate a subject they are learning. Mathematical curiosity also contributes to enhancing student engagement in learning. As explained by Lamnina & Chase (2019), students with a high level of curiosity tend to be more active in the learning process. Pamungkas (2020) emphasizes that curiosity can be fostered through active interactions with teachers and peers, while Qur'ani & Rahayu (2023) highlight that learning experiences in mathematics contribute to the development of students' curiosity. Thus, curiosity is not merely an inherent drive but can also be nurtured through appropriate instructional strategies to encourage students to actively explore mathematical concepts.

Previous studies have examined the relationship between curiosity and numerical literacy, such as Puspitasari et al., (2024), who analyzed it based on average test scores without describing students' thinking processes, and Fidianto et al., (2023), who focused on problem-solving using different numerical literacy indicators. Cahyani et al. (2022) investigated the influence of curiosity on numeracy using a mixed-method approach with statistical tests but did not explore problem-solving strategies in depth. However, no study has specifically described the problem-solving strategies in students' numerical literacy based on their levels of mathematical curiosity. Therefore, this study employs a descriptive qualitative approach to analyze the relationship between these two aspects more

comprehensively. The novelty of this research lies in its exploration of students' numerical literacy problem-solving strategies across different levels of mathematical curiosity, which has not been widely examined in previous studies.

Given this urgency, the present study aims to analyze students' numeracy literacy skills in relation to varying levels of mathematical curiosity. The findings of this study are expected to provide valuable insights into the relationship between mathematical curiosity and numeracy literacy, contributing both theoretically and practically to the development of effective and efficient mathematics learning strategies.

## **METHOD**

This study employs a descriptive qualitative approach to conduct an in-depth analysis of students' numeracy literacy skills based on their level of mathematical curiosity. The research was conducted at a junior high school in Kolaka Regency, Southeast Sulawesi Province. The selection of research subjects was carried out systematically, beginning with the distribution of a mathematical curiosity questionnaire to all students. The questionnaire results were categorized into three levels: high, moderate, and low. After the categorization, purposive sampling was used to select three students representing each category, considering their communication skills and willingness to participate.

The instruments used in this study consist of a mathematical curiosity questionnaire and a numeracy literacy test. The questionnaire was developed based on indicators of curiosity in mathematics learning, while the numeracy literacy test comprises open-ended questions focusing on plane geometry. Before being used, both instruments underwent a validation process by experts in mathematics education. Additionally, the instruments were tested for validity and reliability, with the results indicating that both the questionnaire and the numeracy literacy test have good quality and are valid for measuring students' mathematical curiosity and numeracy literacy skills. Data collection was conducted in two main stages: first, the distribution of the questionnaire to all students to assess their level of mathematical curiosity; second, the administration of the numeracy literacy test to three students selected based on their mathematical curiosity category.

Data analysis was carried out in three stages: data reduction, data presentation, and conclusion drawing. Data reduction involved summarizing all collected data and classifying it according to the predetermined categories. The numeracy literacy test results were analyzed based on the responses of the three research subjects and then presented by describing students' numeracy literacy skills based on their written test results and linking them to the established numeracy literacy indicators. The final stage was drawing conclusions to determine the numeracy literacy indicators met by students with different levels of mathematical curiosity (high, moderate, and low). This study is expected to provide a more detailed understanding of the relationship between mathematical curiosity and students' numeracy literacy skills and serve as a foundation for developing more adaptive learning strategies.

**RESULTS AND DISCUSSION**

*Numeracy Literacy Skills of Students with a High Level of Mathematical Curiosity*

The numeracy literacy test results for students with a high level of mathematical curiosity (S-1) are presented in Figure 1, Figure 2, and Figure 3. The analysis was conducted based on three key numeracy literacy indicators: (1) the ability to use numbers and symbols in solving contextual problems, (2) the ability to analyze information presented in various forms of representation, and (3) the ability to interpret analytical results to draw conclusions (Rahma & Reflina, 2023).

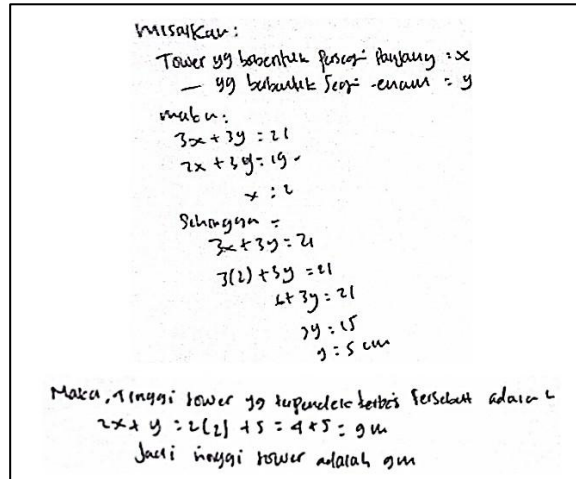


Figure 1. Numeracy literacy test results for a high-curiosity student on the first task

Based on Figure 1, S-1 successfully solved the given problem using appropriate procedures. The student demonstrated the ability to recognize patterns in tower arrangements, apply numbers and symbols correctly in calculations, and obtain the expected answer, fulfilling the first indicator. Additionally, the student effectively analyzed visual information (a tower illustration with different geometric shapes) and understood the relationships between elements within the pattern, satisfying the second indicator. In terms of interpretation (third indicator), S-1 accurately determined the height of the third tower based on the analyzed pattern, indicating a comprehensive understanding of the problem.

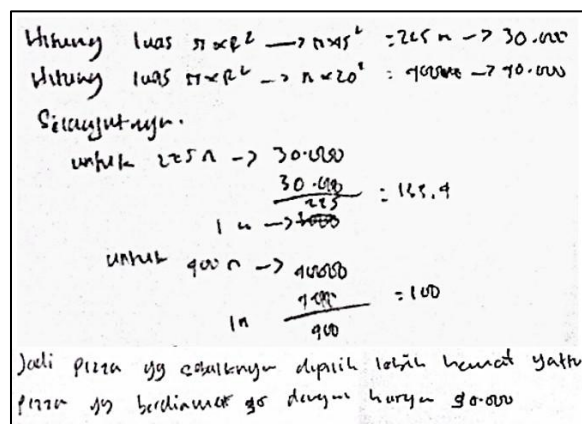


Figure 2. Numeracy literacy test results for a high-curiosity student on the second task

Similarly, in Figure 2, S-1 displayed a strong grasp of all numeracy literacy indicators. The student correctly applied numerical and symbolic reasoning to determine the most cost-effective pizza (first indicator). Furthermore, they effectively analyzed numerical information (diameter and price) and converted it into a price-per-area comparison, demonstrating mastery of the second indicator. Finally, the student provided a well-articulated answer, including a clear conclusion regarding the optimal choice, thereby fulfilling the third indicator.

Jawaban  
 bahan yg diperlukan untuk setiap mobilnya.  
 untuk besi : banyaknya ns mobil yg dapat dibuat = 27 : 7  
 = 3 mobil  
 untuk kulit : banyaknya bahan <sup>untuk</sup> ~~untuk~~ dibuat : 15 :  
 = 85 (8 mobil)  
 untuk ban : banyaknya bahan mobil yg dapat dibuat  
 = 30.4 : 7

Figure 3. Numeracy literacy test results for a high-curiosity student on the third task

In Figure 3, S-1 correctly utilized numbers and symbols in calculations (first indicator) and successfully analyzed tabular data to determine the number of toy cars that could be made from each available material (second indicator). However, the student did not complete the final calculation to determine the total number of toy cars that could be produced, failing to fully integrate the data into a comprehensive conclusion (third indicator).

Overall, these results indicate that students with a high level of mathematical curiosity exhibit strong numeracy literacy skills. This finding aligns with research by Siregar et al. (2023), which demonstrated a positive and significant correlation between curiosity and numeracy literacy skills. A high level of curiosity encourages students to explore information in greater depth, recognize patterns, and apply effective problem-solving strategies. The ability of S-1 to correctly answer all questions reflects strong analytical and critical thinking skills, which are essential for enhancing numeracy literacy (Setiani & Suyitno, 2021). Continuous development of curiosity and numeracy skills enables students to solve mathematical problems more effectively in real-life contexts (Rahmah et al., 2024; Nugroho, 2019).

***Numeracy Literacy Skills of Students with a Moderate Level of Mathematical Curiosity***

The numeracy literacy test results for students with a moderate level of mathematical curiosity (S-2) are presented in Figure 4, Figure 5, and Figure 6.

1. Diketahui tinggi 21 meter  
 Diketahui sedang 19 meter  
 Diketahui pendek 9 meter

Figure 4. Numeracy literacy test results for a moderate-curiosity student on the first task

In Figure 4, S-2 provided only the final answer without showing the calculation process. Although the answer was correct, the absence of detailed steps made it difficult to evaluate how the student applied numbers and symbols or analyzed the given information. This suggests that while the student was able to derive the correct answer, they were not accustomed to systematically documenting the problem-solving process. Developing the habit of writing out solutions not only enhances mathematical reasoning but also strengthens numeracy literacy, particularly in terms of mathematical communication and reflection on problem-solving strategies.

hitung luas  $\pi \times R^2 \rightarrow \pi \times 15^2 = 225\pi \rightarrow 30.000$   
 hitung luas  $\pi \times R^2 \rightarrow \pi \times 20^2 = 400\pi \rightarrow 40.000$   
 selanjutnya :  
 untuk  $225\pi \rightarrow 30.000$   
 $225\pi \rightarrow \frac{30.000}{225} = 133,4$   
 untuk  $400\pi \rightarrow 40.000$   
 $400\pi \rightarrow \frac{40.000}{400} = 100$

Figure 5. Numeracy literacy test results for a moderate-curiosity student on the second task

Figure 5 shows that S-2 correctly outlined the steps for solving the problem, demonstrating proficiency in using numbers and symbols for calculations and analyzing numerical information (first and second indicators). However, the student did not explicitly state which pizza was the most cost-effective. Despite a solid grasp of calculations, the failure to provide a conclusive answer indicates an incomplete fulfillment of the third indicator—interpreting results to draw conclusions. This suggests that while S-2 can process mathematical information effectively, they require further development in completing problem-solving tasks comprehensively.

untuk menentukan banyaknya mobil yang dapat dibuat langsung  
 yang dilakukan adalah membagi jumlah bahan yang tersedia  
 dengan jumlah bahan yang diperlukan untuk setiap mobilnya.  
 untuk lidi : banyaknya mobil yang dapat dibuat =  $27:3 = 9$  mobil  
 untuk kulit : banyaknya mobil yang dapat dibuat =  $30:4 = 7,5 (<$   
 mobil)  
 jadi banyaknya mobil mainan yang dapat dibuat adalah  $7$  mobil.

Figure 6. Numeracy literacy test results for a moderate-curiosity student on the third task

In Figure 6, S-2 demonstrated accuracy in several calculations but made an error in selecting the relevant numerical values. Instead of using the data related to the available orange peel material, the student mistakenly referenced numbers associated with car tires. Although the final answer was correct, this mistake indicates a lack of precision in analyzing tabular information (second indicator). Furthermore, S-2 did not determine the number of toy cars that could be produced based on the

available materials, leaving the third indicator—interpreting and concluding the analysis—unmet.

Overall, students with a moderate level of mathematical curiosity exhibit a reasonable understanding of numeracy, particularly in performing calculations and analyzing various forms of information. A moderate level of curiosity allows students to explore problems to the extent of calculations and analysis but does not always encourage them to present complete solutions or explicitly draw conclusions. This finding aligns with Jannah et al. (2021), who argue that curiosity promotes active thinking and critical observation, thereby deepening students' understanding of mathematical concepts. Hutagalung (2022) further emphasizes that curiosity activates the mind, encouraging students to ask questions, seek additional information beyond textbooks, and engage in discussions. While these students show an interest in problem-solving, additional guidance is needed to help them develop the habit of presenting complete solutions and systematically drawing conclusions. Strengthening reflective skills and attention to detail in constructing comprehensive answers is crucial for optimizing their numeracy literacy in real-world applications.

**Numeracy Literacy Skills of Students with a Low Level of Mathematical Curiosity**

The numeracy literacy test results for students with a low level of mathematical curiosity (S-3) are presented in Figure 7 and Figure 8.

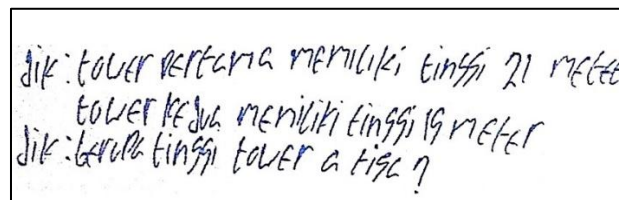


Figure 7. Numeracy literacy test results for a low-curiosity student on the first task

As shown in Figure 7, S-3 only identified the "given" and "asked" information from the problem statement without proceeding to the solution. This suggests that while the student could recognize relevant details from the problem, they struggled to progress to the analytical and problem-solving stages. Such responses indicate an initial understanding of the problem but highlight the need for additional support to help students develop problem-solving strategies and complete calculations independently. Building confidence and problem-exploration skills may facilitate the enhancement of their numeracy literacy.

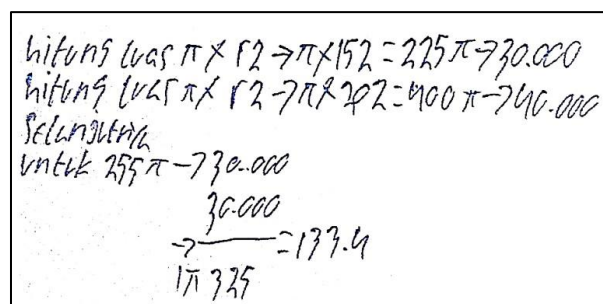


Figure 8. Numeracy literacy test results for a low-curiosity student on the second task

Figure 8 reveals that S-3 performed calculations to determine the area of the pizzas, demonstrating an understanding of numerical and symbolic application in a numeracy context (first indicator). However, after obtaining the pizza areas, the student did not proceed to the price comparison stage and failed to draw a conclusion regarding the most cost-effective option. This indicates that while the student could initiate the solution process, they did not complete the full analysis (second indicator) or interpret the results to form a conclusion (third indicator).

For the third question, S-3 left the problem unanswered, suggesting significant difficulty in processing complex information, such as tabular data. This difficulty may indicate that the student is unfamiliar with interpreting and utilizing numeracy-based data representations. Therefore, strengthening students' abilities in data analysis and information interpretation is essential to help them develop systematic problem-solving strategies and complete mathematical calculations. Overall, students with a low level of mathematical curiosity exhibit limited numeracy literacy skills, particularly in completing problems comprehensively. While they can identify relevant information and begin calculations in some cases, they often fail to proceed to the analytical and conclusion-drawing stages. A low level of curiosity affects students' engagement in problem-solving, making them less likely to explore information in depth or complete tasks thoroughly (Rahayu & Miterianifa, 2023). According to Cahyani et al. (2022), improving numeracy literacy requires first fostering an interest in mathematics. This can be achieved through various instructional strategies, such as providing motivation before lessons, posing thought-provoking questions that encourage critical thinking, and offering regular problem-solving exercises to enhance numeracy skills. Additionally, rewarding students for successfully solving problems can serve as an incentive to boost engagement and motivation. Through these approaches, students are expected to develop confidence in processing information, analyzing data, and drawing conclusions, ultimately strengthening their numeracy literacy.

The level of mathematical curiosity plays a role in determining students' numeracy literacy skills. One of the strengths of this study is its ability to identify how mathematical curiosity influences various aspects of numeracy problem-solving, from information exploration to decision-making. These findings provide a clearer picture of differences in numeracy comprehension based on students' curiosity levels. However, this study also has limitations, particularly in terms of generalizability, as the sample used is still limited to a specific group. Additionally, other external factors, such as teaching methods and learning environments, have not been fully analyzed in relation to curiosity and numeracy literacy.

A comparison with previous studies reveals both similarities and differences in findings. Fidiyanto et al. (2023) found that students with high curiosity also demonstrated high numeracy literacy skills. This finding suggests that an exploratory drive can help students develop a deeper understanding of numeracy concepts and apply them in various contexts. Conversely, the study by Puspitasari et al. (2024) produced different results, showing that students with high curiosity only achieved a moderate

level of numeracy literacy despite being more actively engaged in the learning process. This discrepancy indicates that curiosity alone is not sufficient to enhance numeracy literacy optimally; it must be supported by appropriate learning strategies and reinforcement of critical thinking skills.

The implications of this study's findings provide insights into efforts to improve students' numeracy literacy through the management of mathematical curiosity. More effective instructional strategies should be developed to encourage deeper exploration and problem-solving. Educators can design interactive and inquiry-based approaches to foster students' curiosity in mathematics learning. Furthermore, the results of this study can serve as a foundation for future research exploring the role of other factors, such as intrinsic motivation and learning styles, in strengthening the relationship between curiosity and numeracy literacy.

## **CONCLUSION**

This study aimed to analyze students' numeracy literacy skills based on their levels of mathematical curiosity. The findings indicate that students with high curiosity demonstrate better numeracy literacy skills, as they tend to explore information more deeply and apply appropriate problem-solving strategies. In contrast, students with moderate curiosity show adequate numeracy skills but require further encouragement to present complete solution processes. Meanwhile, students with low curiosity tend to be less engaged in problem-solving and struggle to analyze and interpret mathematical information comprehensively.

These findings highlight the importance of fostering mathematical curiosity as a key factor in enhancing numeracy literacy. Encouraging curiosity through well-designed instructional strategies, such as critical-thinking questions, diverse problem-solving exercises, and incentive-based learning, can improve students' engagement and problem-solving abilities. Strengthening curiosity-driven learning may contribute to the development of more effective mathematics education, ultimately preparing students to apply numeracy skills in real-life contexts.

This study is limited by its focus on a small sample from a single school, which may affect the generalizability of the findings. Future research should expand the sample size and include students from diverse educational backgrounds to provide a more comprehensive understanding of the relationship between mathematical curiosity and numeracy literacy. Additionally, exploring long-term interventions designed to enhance curiosity and their impact on numeracy skills could offer valuable insights for curriculum development and instructional practices.

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