

An Indicator-Based Analysis of Students' Numeracy in Statistics: A Qualitative Descriptive Study

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ABSTRACT

Purpose – This study analyzes Grade VIII junior high school students' numeracy ability in statistics based on numeracy indicators. Numeracy is essential for everyday life because it enables individuals to understand, use, and evaluate quantitative information in real-world contexts, including making decisions from data.

Methodology – Using a phenomenological approach with a qualitative descriptive design, this study involved 35 Grade VIII students. Data were collected through a numeracy test consisting of numerical description tasks aligned with three indicators: (1) using numbers and basic mathematical symbols, (2) analyzing data in visual form (tables/graphs), and (3) interpreting analytical results as a basis for decision-making. Students' responses were analyzed descriptively by indicator to determine achievement and identify recurring difficulties.

Findings – Performance was highest on using numbers and basic mathematical symbols (82.5%), followed by analyzing visually presented data (61.79%). The lowest achievement was found in interpreting results for decision-making (21.07%). These results suggest that while many students can apply basic numerical procedures and read visual data, they struggle to connect statistical results to justified decisions. Instruction should therefore emphasize interpretation and decision-making through authentic, context-based data tasks.

Novelty – This study offers an indicator-based profile of statistical numeracy using numerical description tasks within a phenomenological, qualitative-descriptive framework, revealing decision-making as the weakest indicator.

Significance – The findings inform teachers, curriculum developers, and assessment designers in developing learning and assessment strategies that strengthen students' statistical interpretation and data-driven decision-making skills.

Keywords: Mathematics education; Numeracy indicators; Qualitative descriptive study; Statistical literacy; Statistics learning; Visual data analysis.

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1. Introduction

Mathematics education has a crucial role in shaping a logical way of thinking so that individuals can become more consistent, active, innovative, independent, and able to handle problems that benefit society (Khairunnisa, 2020). The discipline of mathematics also serves to improve critical thinking and argumentative skills, provide solutions to everyday issues and challenges in the work environment, and support the advancement of science (Zuschaiya et al., 2021). In addition, Mathematics must be taught at every level of education. This opinion is reinforced by the statement Anitra, (2021), in math lessons, several topics relate to other subjects.

The independent curriculum provides numerical ability to boost students' reasoning on the assessment aspects of several subjects, including technology, science, and mathematics (Laelatulfi et al., 2025). Numeracy skills play an important role in supporting education and lifelong learning, both in the classroom, the work environment, and daily life. Numeracy is not only about numeracy skills, but also contains the ability to understand, use, and analyze mathematical concepts appropriately in various real-life contexts (Damanik & Handayani, 2023). Numeracy skills include the ability to perform calculations, read and analyze data, and make decisions based on quantitative information. This shows that numeracy is part of the mathematical thinking skills that are applicable and highly relevant to the challenges of modern times, especially amid technological developments and increasingly rapid information flows.

In today's digital era, numeracy skills are among the most important skills that every individual must possess to compete, adapt, and make rational decisions in daily life and the work environment. Numeracy skills do not only include reading and arithmetic activities, but also include critical thinking skills, solving problems effectively, and making the right decisions in various daily life situations (Ansyah & Mailani, 2024; Cahyani, Iskandar, Sukmawati & Raza, 2024; Sa'dah, Afri, Nurrahmawati & Arcat, 2025; Suryani, Nurrahmawati, Afri & Arcat, 2025). This ability is crucial, especially in the fast-paced and data-driven information era, where every individual is required to be able to understand, process, and interpret a variety of complex numerical information, including statistical data and digital information (Herawan, 2021). Therefore, mastery of numeracy not only impacts academic achievement but also broader life skills, such as personal financial management, understanding of statistics in the media, and active participation in data-driven societies.

Mastery of numeracy skills is one of the main competencies students must possess to address challenges in the world of education in the 21st century. These skills are not only needed in the learning process at school, but also have a significant role in making daily decisions. However, data in the field shows that the level of mastery in numbers among students in Indonesia is still at a low level. Research by Nasoha, Araiku, et al. (2024) found that the importance of numeracy has not had a significant impact on students' mathematical numeracy skills. This is in line with the results of the Programme for International Student Assessment (PISA), which show that Indonesian students still experience difficulties, even in solving basic-level questions, namely levels one and two (Masfufah & Afriansyah, 2021). Similar findings by Yuniati, et al. (2020) stated that most students are in the category of low

numeracy ability, which is 51.06%, while those who belong to the medium and high categories are only 34.04% and 14.89%.

Research conducted by Wahyuni & Aini Faiqotul Himmah, (2024) showed that 63% of high school students were still in the low category in solving statistical material problems, and only 15% of students were able to meet all numeracy indicators. The relationship between the mathematics and numeracy skills of junior high school students is examined, but the study does not specifically highlight statistical material, nor has it analyzed the achievement of each numeracy indicator in detail. Given the problems and limitations that have arisen in previous studies, there is still a need for a more in-depth study to understand how students' numeracy skills develop as they learn specific materials in the classroom. One topic that deserves special analysis is statistics, as this material requires students to understand quantitative information, read and interpret data, and draw conclusions from visual representations such as graphs and tables. Statistics is also a relevant field to measure the application of students' logical and analytical thinking skills in real life.

Based on this, this research aims to reveal and evaluate students' ability to solve numeracy problems related to statistical material using the numeracy indicators determined. Through this analytical approach, it is hoped that the pattern of student achievement can be revealed. Meanwhile, the results of the analysis are also expected to contribute to formulating learning strategies that are more effective, contextual, and adaptive to the needs of students. Therefore, the results of this research can be used as a basis for the development of learning strategies designed to strengthen students' numeracy skills in a comprehensive and sustainable manner

2. Methods

This study applies qualitative methods and uses a phenomenological approach. The researcher's phenomenological approach focuses on how humans, as objects of research, relate to the world of symptoms, both in the context of empirical objects and in relation to the phenomenon of an event or social situation. This approach provides researchers with an opportunity to illustrate students' numeracy abilities in the context of mathematics learning in a natural and structured way. The participants in this study include all grade VIII students in junior high school. A total of 35 students were taken as samples through the technique purposive sampling, which means that sample selection is done based on criteria that reflect the population, or for a specific reason (Asrulla et al., 2023).

The main instrument in this study is a numeracy description test designed and developed based on indicators of numeracy ability, especially in statistical materials. The test consists of 3 description questions that have undergone validation and reliability testing. Indicators include (1) Skills in applying a wide variety of basic mathematical numbers and symbols. (2) Skills in understanding data displayed in various formats, such as graphs, tables, and diagrams. (3) Ability to understand the results of analysis to make predictions and make decisions.

Data was collected directly in the classroom by giving a numeracy description test to students. After the test is completed, students' answers are collected and qualitatively analyzed to describe numeracy skills for each indicator. Data analysis was conducted using a qualitative descriptive approach, grouping exam results into three levels of numerical ability: high, medium, and low. The determination of this category is carried out according to the

percentage score obtained by students using the percentage formula (Sulistyawati Wiwik, Wahyudi, 2022):

$$P = \frac{F}{N} \times 100\%$$

Information:

P: Percentage of acquisition score

F: Total score of each maximum

N: maximum score

Table 1 - Value Interval for Each Category

Value Interval	Category
≥ 71	High
40-70	Medium
≤ 40	Low

(Sari et al., 2021)

The categories of numeracy ability are adjusted by percentage intervals as follows (Kalsum & Sulastri, 2023).

Table 2 - Categories of Numeracy Ability: Each Indicator

Percentage Interval	Category
81-100	Very High
61-80	High
41-60	Medium
21-40	Low
0-20	Very Low

The analysis results are then described for each numeracy indicator to determine the level of student mastery for each numeracy aspect.

3. Results and Discussion

3.1 Result

The study found that 35 students were given three description questions, each aligned with one of three indicators of numeracy ability in the statistics material. Furthermore, the scoring results will be categorized into high, medium, and low. Table 3 shows the numeracy ability test results obtained.

Table 3 - Results of the Mathematical Numeracy Ability Test Category

Criterion	Category	Number of Students	Percentage
$75 < P \leq 100$	High	13	37,14
$60 < P \leq 74$	Medium	6	17,14
$0 < P \leq 59$	Low	16	45,71

Based on the results in Table 3 for the 35 students, most of their mathematical numeracy skills (45.71%) were in the low category, with 13 students. This means that almost half of all test takers showed less than satisfactory results. A total of 6 students, or 37.14% of students, have high numeracy skills, indicating that more than a third can understand numeracy materials well. 17.14% of students are in the medium category, the smallest group.

Mathematical numeracy ability scores are obtained from the results of student tests at SMPN Pekanbaru. Students' mathematical numeracy skills are assessed through essay questions (descriptions), with up to 3 questions for the Statistics material. One question item is designed to measure ability in the context of applying basic mathematical concepts. The first question is designed to measure the extent to which students can use different types of numbers and symbols appropriately and relevantly. Meanwhile, the second question is intended to assess students' capacity to analyze data presented in various visual formats, such as graphs, tables, charts, diagrams, and other data representation media. On the other hand, the focus of the third question is students' ability to evaluate the results of previously conducted analyses, formulate predictions, and determine the most appropriate choices to solve the problems they face. The results of the evaluation of the test are presented in the following description:

Table 4 - Mathematical Numeracy Ability Test Results

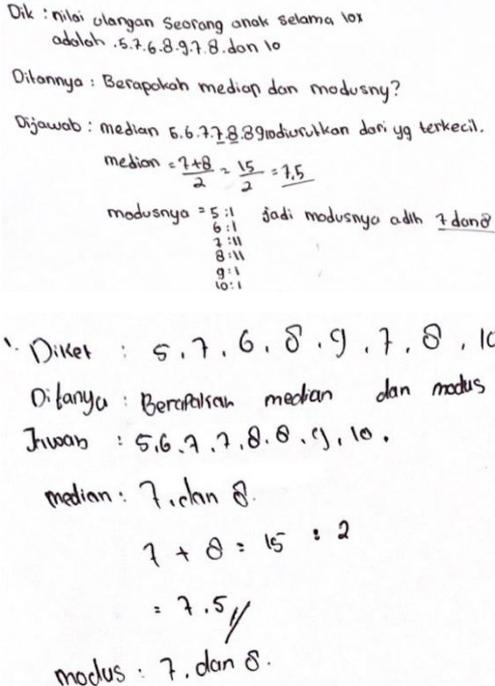
No.	Numeracy Ability Indicators	Percentage of Student Answers (%)
1.	Ability to use a wide variety of numbers or symbols related to basic mathematics	82,5
2.	Ability to analyze information presented in various forms (graphs, tables, charts, diagrams, and so on)	61,79
3.	The ability to interpret the results of the analysis of the problem to predict and make decisions in solving problems.	21,07
Correspondence		55,12

Based on Table 4, the mathematical numeracy ability of grade VII students of SMPN Pekanbaru. shows a varied understanding of the three numeracy indicators. In the second indicator, students showed the highest results with a percentage of 82.5%. This shows that most students are quite skilled at applying various forms of presentation to explain basic principles of mathematics. Then, the second indicator shows a percentage of 61.79%. This means that students are quite good at reading and understanding visual data, though not as strong at using a wide variety of numbers and symbols. Meanwhile, the third indicator only reached 21.07%. This figure shows that many students still have difficulty associating the results of data analysis with the appropriate steps or decisions. Overall, the average of the three indicators was 55.12%, indicating that students, in general, have abilities that are still at a moderate level and need improvement.

Next, the researcher analyzed the students' written responses and interview data, then selected the participants based on their numeracy ability levels. The three subjects were categorized as follows: S1 represented students with high numeracy ability, S2 represented students with moderate numeracy ability, and S3 represented students with low numeracy ability.

This analysis examines the meaning and completeness of students' responses in relation to their ability to use a wide variety of numbers and mathematical symbols in basic mathematics. The students' answers were evaluated to determine how accurately they interpreted mathematical problems, how appropriately they selected and applied numerical representations and symbols, and how completely they expressed their reasoning. This analysis provides insight into the students' levels of understanding and their proficiency in using fundamental mathematical concepts symbolically.

Table 5 - Analysis of the Meaning and Completion of Student Answers

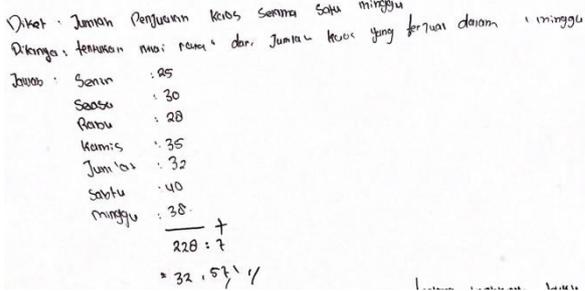
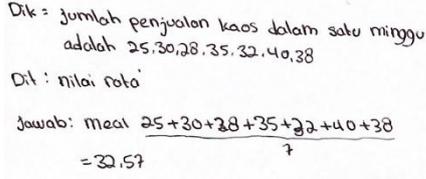
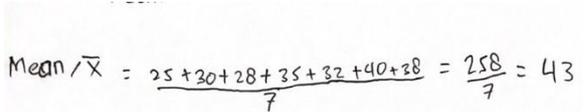
Picture	Interpretation
 <p>Dik : nilai ulangan seorang anak selama 10x adalah 5, 6, 7, 7, 8, 8, 9, 10</p> <p>Ditanya : Berapakah median dan modusnya?</p> <p>Dijawab : median 5, 6, 7, 7, 8, 8, 9, 10 diurutkan dari yg terkecil.</p> $\text{median} = \frac{7+8}{2} = \frac{15}{2} = 7,5$ <p>modusnya = 5 : 1 6 : 1 7 : 2 8 : 2 9 : 1 10 : 1</p> <p>Jadi modusnya adlh 7 dan 8</p> <p>Diket : 5, 6, 7, 7, 8, 8, 9, 10.</p> <p>Ditanya : Berapakah median dan modusnya?</p> <p>Jawab : 5, 6, 7, 7, 8, 8, 9, 10.</p> <p>median : 7, dan 8.</p> $7 + 8 = 15 : 2$ $= 7,5 //$ <p>modus : 7, dan 8.</p>	<p>From the students' responses, it appears that those in the high (S1) and medium (S2) categories can answer question No. 1 correctly and accurately. This shows that S1 and S2 students already have skills in using various forms of numbers and symbols related to basic mathematical concepts.</p>
<p>Median = 5, 6, 7, 7, 8, 8, 9, 10 = $7+8 = 15 : 2 = 7,5$.</p> <p>modus = 7 dan 8</p>	<p>From the students' answers, it can be seen that students in the lower categories (S3) can answer questions correctly but have not yet organized the data they understand and the questions they contain.</p>

Researcher (P) interviews students to add data and information about mathematical calculation skills. Here is an excerpt from the interview:

- P : Why don't you include the information and questions that are known in the question?
- S3 : Because I think the result will remain the same even if it does not include what is known and questionable.

This analysis examines the meaning and completeness of students' responses to questions designed to measure their ability to analyze information presented in various forms, such as graphs, tables, charts, and diagrams. The students' answers were evaluated to determine how well they interpreted visual data, identified relevant information, and provided logical and complete explanations. This analysis aims to assess the depth of students' understanding and their capacity to extract and process information from different mathematical representations.

Table 6 - Analysis of the Meaning and Completion of Student Answers

Picture	Interpretation
 <p>Diket: Jumlah Penjualan kaos selama satu minggu Ditanya: tentukan rata-rata dari jumlah kaos yang terjual dalam 1 minggu</p> <p>Jawab: Senin : 25 Selasa : 30 Rabu : 28 Kamis : 35 Jumat : 32 Sabtu : 40 Minggu : 38</p> $\frac{25+30+28+35+32+40+38}{7} = 32,57$	<p>Students in the high (S1) and medium (S2) categories show full understanding. This can be seen in the responses of students who correctly sum the data, then use the average formula correctly. So the mean obtained is correct: 32.57. And S1 students are able to analyze the information provided in the bar chart appropriately, while students (S2) are not complete in writing the information contained in the bar chart, where S2 does not write down the day</p>
 <p>Dik: jumlah penjualan kaos dalam satu minggu adalah 25,30,28,35,32,40,38</p> <p>Dit: nilai rata-rata</p> <p>Jawab: rata-rata $\frac{25+30+28+35+32+40+38}{7} = 32,57$</p>	<p>Students with low categories showed that they were unable to write, were asked and known, were unable to complete the calculation process accurately. This can be seen from the students' responses which showed the mean they got was 43, while the correct mean answer was 32.57.</p>
 <p>Mean / $\bar{x} = \frac{25+30+28+35+32+40+38}{7} = \frac{258}{7} = 43$</p>	

To add data and information about mathematical numeracy skills, researchers (P) conducted interviews with medium category (S2) students. Here is an excerpt from the interview:

P : Is the data you recorded in line with what is stated on the bar chart?
S2 : Yes, but I just wrote the grades without writing the day, because all I used was the grades to do the problem.

To add information on mathematical numeracy skills, the researcher (P) conducted interviews with students in the low category (S3). Here is an excerpt from the interview:

P : Why is the result of your answer only the result without writing down what is known and asking the question?

S3 : Because I don't yet understand how to identify the known and the asked from the questions given

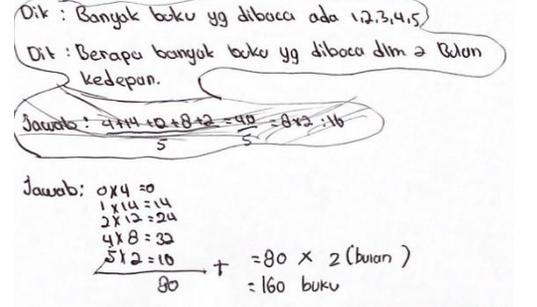
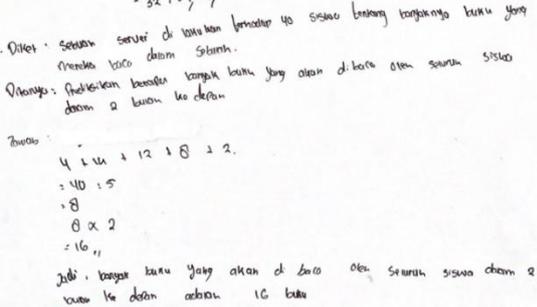
P : Do you believe the answer you give?
S3: I have doubts because I suspect an error in the data calculation.

P : Why do you think it's wrong?
S3 : Because after seeing the results of other friends, my answer is different. And after me, on the other hand, the result was the same as my friend's.

This analysis examines the meaning and completeness of students' responses related to their ability to understand and interpret the results of problem analysis in order to make

appropriate predictions and decisions. The evaluation focuses on how well students connect analytical findings to logical conclusions, justify their predictions, and demonstrate sound reasoning in selecting solutions. Through this analysis, the researcher aims to assess students' higher-order thinking skills in interpreting results and applying them effectively in problem-solving contexts.

Table 7 - Analysis of the Meaning and Completion of Student Answers

Picture	Interpretation
 <p>Dik : Banyak buku yg dibaca ada 1,2,3,4,5 Dit : Berapa banyak buku yg dibaca dlm 2 bulan kedepan. Jawab : $\frac{0+14+2+8+2}{5} = \frac{40}{5} = 8 \times 2 = 16$ Jawab : $0 \times 4 = 0$ $1 \times 14 = 14$ $2 \times 12 = 24$ $4 \times 8 = 32$ $5 \times 2 = 10$ $\frac{80}{5} = 160$ buku</p>	<p>Students in the high category (S1) and medium category (S2) show good ability in understanding the information presented accurately and accurately, this can be seen from the answers known and asked are correct. However, in looking for answers, S1 and S2 still make a mistake, namely not looking for the average, they should write the average first, namely</p> $[(0 \times 4) + (1 \times 14) + (4 \times 8) + (5 \times 2)] \div 40 = 80 \div 40$ <p>= 2 books per student in a month. After that, we continue to predict for the final answer.</p>
 <p>Diket : Sebuah server di buku dan format 40 siswa banyak banyaknya buku yang mereka tulis dalam sebuah. Ditanya : Hitunglah banyak buku yang akan di baca oleh semua siswa dalam 2 bulan kedepan. Jawab : $4 + 14 + 12 + 8 + 2 = 40 : 5 = 8$ $8 \times 2 = 16$ Jadi : banyak buku yang akan di baca oleh semua siswa dalam 2 bulan kedepan adalah 16 buku</p>	<p>Based on students' answers, it can be seen that students with low abilities (S3) are less able to understand the information provided accurately. This can be seen from the response of students who did not write down known and asked questions about the questions. However, students with low categories (S3) have taken the first step in answering questions, namely the average that is correct is 2, but students (S3) are not able to make predictions as requested by the question. where S3 students only answer up to the average score.</p>
<p>= $0 \times 4, 1 \times 14, 2 \times 12, 4 \times 8, 5 \times 2$ = $0 + 14 + 24 + 32 + 10 = 80$! Banyak siswa = $80 : 40 = 2$</p>	

To obtain data and more detailed information about mathematical numeracy skills, the researcher (P) conducted interviews with three students representing each category: high (S1), medium (S2), and low (S3). The following is an excerpt from the interview:

P : What difficulties do you feel in working on question No. 3?

S1: I'm confused about which formula is used to find the averages presented in the table.

S2 : I don't know what steps are taken in answering questions. I answered according to what I understood.

S3: I know the formula for finding the average, but I'm confused about how to extend the average to predict how many books to read in the next 2 months.

3.2 Discussion

3.2.1 Ability to use a wide variety of numbers or symbols related to basic mathematics

Based on the analysis of Table 4 and the interview results, S3 students have not written the information known and questioned in the question. This is because students feel it is unnecessary. Thus, S3 students already know the information presented in the questions. It's just that S3 students feel that they can answer questions without having to list what they know and ask first. This is because students are able to study the information in the questions well, so that they can analyze appropriately and complete calculations accurately and correctly (Laimeheriwa et al., 2024).

Based on the analysis that has been carried out, it shows that students who are included in the high category (S1) are able to solve problems accurately, which is in line with the findings made by Taqwani, Ratnaningsih, & Rahayu, (2024) mention that students in the high ability category show the ability to apply numbers and symbols appropriately in order to obtain solutions to the problems they face. Students in the medium (S2) and low (S3) categories also did not have difficulty answering. The first question focused on the ability to use various types of numbers and symbols to represent basic mathematical concepts. This shows that all student groups have understood the basic concepts of data processing in mathematics, especially in determining median and mode values. Evidence of this understanding can be seen in students' answers, which show a high level of accuracy and truthfulness in responding to questions about median values and modes.

The results of the analysis in Table 4 show that students with ability indicators who use various kinds of numbers or symbols related to basic mathematics already have a high level of ability, as evidenced by the 82.5% obtained. This is in line with Juanti, Imamuddin, & Risnawita, (2024) which states that the first indicator has the highest percentage, indicating that students can work on practical problems in real life by using various forms of numbers and symbols that represent basic mathematical concepts.

3.2.2 Ability to analyze information presented in various forms (graphs, tables, charts, diagrams, and so on)

Based on the analysis of Table 6, S1 students working on the questions can record or represent the information in the bar chart accurately. However, S2 students can give correct answers to the questions, but have not fully presented the information listed in the questions. Because S2 students feel that in doing questions, they only need to use their grades. Meanwhile, S3 students who are working on questions do not understand where to start, and make mistakes in the process of summing data.

The analysis showed that S1 students had met the 2nd indicator, whereas S2 and S3 students were still unable to analyze the information in the diagram. Things are in harmony with Khoirunnisa & Adirakasiwi, (2023), which states that students fail to provide proper answers when analyzing the provided data. The inability of S2 and S3 students to analyze information from diagrams shows that this weakness can be caused by several factors, such as a lack of habituation to reading data representations and a limited understanding of basic mathematical concepts.

The level of students' numeracy mastery in analyzing data presented in various forms, such as graphs, tables, and diagrams, was 61.79%, indicating that students' competence falls into the medium category. These findings are consistent with those of Saputri, Sari, Lestaria, & Ningsih (2023), who reported that students' ability to analyze information in a visual format reached 70.59%, which was also classified as medium. The data show that the students'

numeracy ability on the 2nd indicator falls within the medium category (Silvia & Asdarina, 2024).

3.2.3 *The ability to interpret the results of the analysis to predict and make decisions in solving problems.*

Based on the results in Table 7 and the interview, students still make mistakes when working on question 3. S1 has not taken steps to solve the average to answer question number 3. This is because S1 is confused about which formula is used to find the average presented in the form of a table. S2 has not answered correctly because he does not know the steps for answering questions; he only answers what he understands. While S3 students have been able to complete the average, they are confused about how to continue the average to predict the number of books read in the next 2 months.

The analysis shows that many students still face challenges in understanding problems, especially in predicting and making the right decisions. This statement is in line with the opinion Ate & Lede, (2022) which states that the main obstacle faced by students is their inability to determine the right approach to solving problems that suit the problem's characteristics. From the analysis results, it can be seen that S1, S2, and S3 students have not been able to interpret the answer results, so there is no complete or correct answer. This phenomenon is reinforced by the results of the research Mutmainah, Ruswana, & Solihah, (2023) said that, based on the analysis, the subject could give technically correct answers, but the students were unable to interpret the answers in depth.

The level of students' numeracy ability in indicators related to interpreting the results of problem analysis to predict and make decisions in solving problems is in the low category, with a percentage of 21.07%. This statement is also said by Irwandi, Hutapea, & Yuanita, (2024) that it is still very low in the ability to explain the results of the analysis which is used as a basis for formulating predictions and rational decision-making. This is because the most challenging indicator for students is to decipher the results of the analysis process as the basis for making predictions and making appropriate decisions (Laelatulfi et al., 2025).

4. Conclusions

Based on the study's results, it can be stated that the mathematics skills of students in grade VIII at the junior high school level in statistics materials are generally still relatively moderate to low, with an average score of 55.12%. When analyzed based on different indicators, the highest ability is seen in the first indicator; on the other hand, the numeracy ability of students in the second indicator is classified as moderate, and the numeracy ability of students in indicator is low.

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Conflict of Interest

The authors declare no conflicts of interest.

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