

Analysis of Students' Conceptual Understanding Ability in Solving Word Problems on Basic Statistics

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ABSTRAK	ABSTRACT
<p>Penelitian ini bertujuan untuk menganalisis kemampuan pemahaman konsep matematis siswa kelas VIII SMP Negeri 2 Sompak pada materi statistika dasar, mengidentifikasi hambatan yang dihadapi siswa dalam menyelesaikan soal cerita, serta menganalisis faktor-faktor yang mempengaruhi kemampuan tersebut. Penelitian ini menggunakan pendekatan kualitatif deskriptif dengan subjek 25 siswa kelas VIII C (11 laki-laki, 15 perempuan) yang dipilih melalui purposive sampling. Teknik pengumpulan data meliputi tes esai untuk mengukur empat indikator pemahaman konsep (menyatakan ulang konsep, mengklasifikasikan objek, menerapkan konsep secara matematis, dan menyajikan konsep dalam representasi), wawancara semi-terstruktur kepada 3 siswa terpilih, serta dokumentasi. Analisis data dilakukan melalui reduksi data, penyajian data, dan penarikan kesimpulan, dengan triangulasi sumber, teknik, dan waktu untuk memastikan validitas. Hasil penelitian menunjukkan variasi kemampuan siswa dalam tiga kategori: tinggi (9 siswa, dominan perempuan), sedang (8 siswa, dominan laki-laki), dan rendah (8 siswa). Siswa kategori tinggi mampu menyatakan ulang konsep mean, median, dan modus; mengklasifikasikan data berdasarkan tendensi sentral; menerapkan konsep kuartil secara matematis; serta menyajikan data dalam representasi runtut. Analisis mendalam pada siswa LA (skor tertinggi 19) mengonfirmasi pemenuhan indikator melalui jawaban mandiri. Hambatan utama meliputi kesulitan menyatakan ulang masalah, mengubah soal cerita ke model matematika, dan lemahnya penguasaan konsep dasar. Faktor yang mempengaruhi mencakup motivasi, gaya belajar, pengalaman belajar, serta variasi metode pembelajaran.</p> <p>Kata Kunci: Kemampuan Pemahaman Konsep; Siswa; Soal Cerita; Statistika Dasar; Kelas VIII SMP Negeri 2 Sompak.</p>	<p>This study aims to analyze the mathematical concept comprehension ability of eighth grade students of SMP Negeri 2 Sompak on basic statistics material, identify obstacles faced by students in solving word problems, and analyze factors that influence these abilities. This study used a descriptive qualitative approach with 25 students of class VIII C (11 boys, 15 girls) selected through purposive sampling. Data collection techniques included an essay test to measure four indicators of conceptual understanding (restating concepts, classifying objects, applying concepts mathematically, and presenting concepts in representations), semi-structured interviews with 3 selected students, and documentation. Data analysis was carried out through data reduction, data presentation, and drawing conclusions, with triangulation of sources, techniques, and time to ensure validity. The results showed variations in student abilities in three categories: high (9 students, predominantly female), medium (8 students, predominantly male), and low (8 students). Students in the high category were able to restate the concepts of mean, median, and mode; classify data based on central tendency; apply the concept of quartiles mathematically; and present data in a sequential representation. In-depth analysis of LA students (highest score 19) confirmed the fulfillment of indicators through independent responses. Key obstacles included difficulty restating problems, converting word problems into mathematical models, and weak mastery of basic concepts. Influencing factors included motivation, learning style, learning experience, and variations in teaching methods.</p> <p>Keywords: Conceptual Understanding Ability; Students; Story Problems; Basic Statistics; Class VIII of SMP Negeri 2 Sompak.</p>

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1. INTRODUCTION

Conceptual understanding is the ability to comprehend and explain a situation or action during the learning process (Fahrudin et al., 2018; Afriansyah et al., 2024). The importance of conceptual understanding in mathematics learning lies in its nature as a skill related to the translation of mathematical ideas, which are global and functional, serving as a fundamental part of the mathematics learning process (Darmawanti, 2020; Putri & Nasution, 2023). Furthermore, conceptual understanding is a capability that students must possess when learning mathematics. It is considered a crucial cognitive aspect of mathematics education because mathematics is not merely about memorization; it requires understanding concepts to be applied in daily activities.

However, many students still experience difficulties in understanding concepts, even though conceptual understanding is an essential basic ability that students must possess, especially in mathematics learning (Febriantika, 2020; Miatun & Ulfah, 2023; Saepuloh, Luritawaty, & Afriansyah, 2024). Thus, conceptual understanding serves as a vital foundation for understanding principles and theories in mathematics education. If concepts are not properly understood, students will struggle to comprehend mathematical principles and theories. Therefore, conceptual understanding must be mastered first so that students can follow mathematics learning effectively.

Statistics is a subject in mathematics that studies the collection of data presented in the form of diagrams, graphs, tables, and histograms to facilitate the analysis of data closely related to our daily lives (Sriwahyuni & Maryati, 2022; Suharianto et al., 2024). Additionally, statistics is viewed as a tool for solving problems that constantly occur in everyday life, in the workplace, and in science (Dzulfikar, 2022). According to Tajulfitri (2019), the importance of statistics in Indonesia is also marked by the establishment of the Central Bureau of Statistics (BPS) by the government, tasked with carrying out government duties in the field of statistics in accordance with legislation. This indicates that statistics is a subject closely related to daily life.

Although statistics material has been taught thoroughly, some students still find it difficult when faced with word problems. Most issues arise because they fail to restate the problem to be solved, and students are imprecise in converting word problems into mathematical models, leading to frequent errors in solving them.

Based on this background, the research questions are: How is the conceptual understanding ability of Grade VIII students at SMP Negeri 2 Sompak in solving word problems on basic statistics material? What obstacles do students experience in understanding and solving word problems on basic statistics material? What factors influence students' conceptual understanding ability in basic statistics material?

The research conducted a review of various relevant literature or previous studies related to the focus of this research. Results from previous studies indicate that students' mathematical conceptual understanding falls into high category (17%), medium category (10%), and low category (73%) (Mayasari & Habeahan, 2021b). While sharing the same qualitative research type with test and interview data collection techniques, the difference lies in the location, year of research, number of subjects, and the material used; this study focuses on basic statistics. Another study showed that most students struggle to understand basic statistical concepts due to weak mastery of basic mathematical concepts, difficulty connecting concepts with real contexts, and a lack of variety in teaching methods (Mardhotillah, 2025). Furthermore, research by Zulfa Nurani (2024) showed that the mathematical conceptual understanding ability of Grade XI MIA students had an average percentage in the low category reaching 58.3%, with male students in high and medium categories understanding mathematical concepts better than females. The difference with the current research lies in the number of subjects, location, time, and specific focus on statistics rather than gender differences.

The objectives of this study are as follows: To determine the conceptual understanding ability of Grade VIII students at SMP Negeri 2 Sompak in solving word problems on basic statistics material; to identify the obstacles faced by students; and to analyze the factors influencing these abilities.

2. METHOD

The type of research used in this study is qualitative research with a descriptive method. Qualitative research is a type of research that produces analytical methods that do not use statistical analysis methods as in quantitative research (Rusandi & Muhammad Rusli, 2021). This research method aims to describe the conditions faced when the research was conducted on basic statistics material (Chamdani, 2023). Additionally, theoretical studies are used as a general overview listed in the background of the research and as a subject matter to obtain research results. Based on this explanation, qualitative research is defined as a research process that produces descriptive data in the form of written or spoken words used to describe in detail an event or experience based on reality in the field.

This research was conducted in Class VIII A at SMP Negeri 2 Sompak, located at Jln. Desa Pakumbang No. 55, Sompak District, Landak Regency, West Kalimantan Province, postal code

78363. This research was carried out in the even semester of the 2025/2026 academic year. The subjects of this study were 25 students of Class VIII C, selected using purposive sampling. Purposive sampling is a data source sampling technique performed with specific considerations (Lenaini, 2021).

In this study, three subjects were selected to represent the 25 students in Class VIII C. The researcher used purposive sampling to determine the three subjects based on specific criteria. They were then interviewed regarding the difficulties they faced and their responses to the conceptual understanding ability test on basic statistics material.

Data collection techniques are methods used by researchers to systematically collect data from various sources, such as observations and secondary data (Mukhamad Fathoni, 2019). Data collection involves interviews, observations, testing, archives, and documentation. The test is essentially a tool encompassing a series of tasks performed or questions answered by students to measure specific behavioral aspects (Pitaloka et al., 2021). The test results provide information related to individual or group characteristics used to gauge the level of student conceptual understanding.

An interview is a process of obtaining information for research purposes through direct question and answer between the interviewer and the respondent (Leniwati & Arafat, 2017). One of the interview methods in qualitative research is the semi-structured interview, where the interviewer creates a list of questions, but the sequence remains flexible depending on the direction of the conversation (Rivaldi et al., 2023). Documentation is defined as recording and categorizing information into text, photos, images, and videos (Hasan, 2022).

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3. RESULT AND DISCUSSION

This research was conducted at SMP Negeri 2 Sompak focusing on the mathematical conceptual understanding ability of Grade VIII students, particularly on statistics material. The researcher requested permission from the principal on October 21, 2025, then administered the essay test on mathematical conceptual understanding on November 4, 2025, in Class VIII C. Interviews were conducted on November 11, 2025, with three selected students based on specific criteria to deepen the understanding of test answers.

The essay test was given directly to 25 students of Class VIII C (11 males, 15 females) to measure four indicators: classifying objects, giving examples/non-examples, changing concept representations, and applying concepts in problem-solving. The results showed: High category: 9 students (5 females, 4 males), Medium category: 8 students (6 males, 2 females), and Low category: 8 students (4 males, 4 females). This categorization helps teachers identify student levels and design appropriate learning strategies. Subject LA was selected for in-depth analysis because she achieved the highest score (19) and demonstrated ease of communication. LA answered 4 test questions with high scores, and the interview confirmed independent answers that met the indicators of conceptual understanding.

a. Research Findings

1) Indicator: Restating Learned Concepts

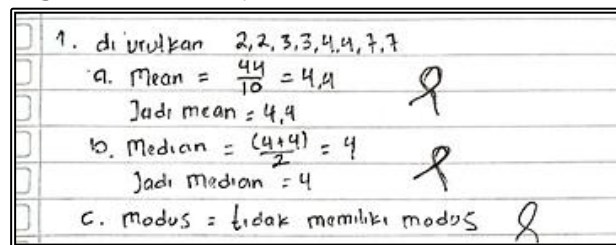


Figure 1. LA Subject Answer Sheet Question Number 1

Based on the written work (Figure 1), Subject LA was asked to calculate the mean, median, and mode. For the mean, the subject wrote the example correctly. For the median, the subject also provided the correct answer according to the applicable concept. However, for the mode, the subject correctly concluded that the data did not have a mode. Therefore, Subject LA has largely met the indicator, capable of understanding and using numerical concepts in various forms. This is reinforced by the interview results:

Researcher: "What do you know about the mean?"

Subject LA: "I know the mean is the average. I summed all values... total 44. Then divided by the number of data points, 10, so $44/10 = 4.4$. In my opinion, the mean is to see the class average score."

Researcher: "What is the difference between median and mean?"

Subject LA: "As far as I know, after sorting the data... The median is the middle number. Since there are 10 data points (even), take the average of the two middle ones... so 4."

Researcher: "What is the function of the mode?"

Subject LA: "I looked at the data, and I concluded that it does not have a mode."

Based on written work and interviews, Subject LA demonstrated a basic understanding of three main concepts in statistics to determine central tendency values correctly.

2) Indicator: Classifying Objects Based on Mathematical Concepts

2. misalkan P = Banyak Siswa pria
 W = Banyak Siswa wanita
 Maka: Jumlah Siswa pria dan wanita = 137
 $\frac{135 + 140W}{P+W} = 137$
 $135P + 140W = 137(P+W)$
 Jadi perbandingan $\frac{W}{P} = \frac{2}{3}$
 Sehingga didapat perbandingan $W:P = 2:3$
 Jadi banyak siswa pria adalah
 $\frac{P}{P+W} 40 = 24$ Siswa pria

Figure 2. LA Subject Answer Sheet Question Number 2

Based on the written work (Figure 2), Subject LA was asked to provide an example of a ratio involving the number of male and female students. In the written answer, the subject successfully showed a correct example of a ratio problem. This indicates that the subject can perceive the ratio between the number of male and female students according to the learned concept. This statement is supported by the interview:

Researcher: "Is the idea for answer number 2 your own?"

Subject LA: "Yes, it's my own idea. I can distinguish the ratio between the number of male and female students based on the definition I learned."

Researcher: "How did you determine the number of male students?"

Subject LA: "As far as I know... using the formula... so the ratio $w:p = 2:3$, then I concluded the number of male students is 24."

Subject LA showed an accurate understanding of the concept independently, proving that the subject met the indicator of classifying objects based on mathematical concepts.

3) Indicator: Applying Concepts Mathematically

3. Data 5, 9, 7, 6, 5, 6, 7, 5, 8, 9, 6, 10
 Ditanya: mean
 Jawab: $\frac{5+9+7+6+5+6+7+5+8+9+6+10}{12}$
 $= \frac{83}{12}$
 $= 6,9$
 Jadi mean = 6,9

19 Point

Figure 3. LA Subject Answer Sheet Question Number 3

Based on the written work (Figure 3), Subject LA was asked to demonstrate the application of the mean concept mathematically. The student was able to identify data, perform addition operations, and division to obtain the mean result. This shows that the subject understands the application of the mean concept.

Researcher: "Can you explain the first step: how to identify data and sum it up?"

Subject LA: "Yes, sir, there are 12 numbers. I summed them one by one... Total 83."

Researcher: "Good! Why divided by 12?"

Subject LA: "Divided by the amount of data, 12, because mean is the average. $83 \div 12 = 6.916$, rounded to 6.9."

Based on written work and interviews, Subject LA was able to demonstrate the application of the mean concept accurately and independently.

4) Indicator: Presenting Concepts in Representational Forms

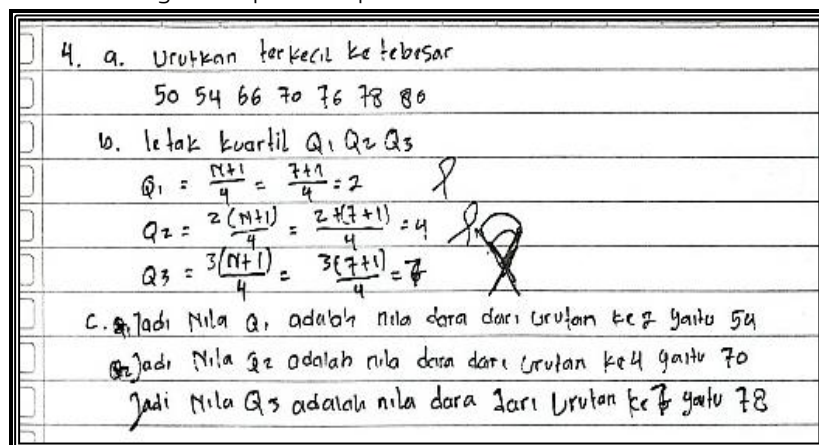


Figure 4. LA Subject Answer Sheet Question Number 4

Based on the written work (Figure 4), Subject LA was asked to demonstrate the application of the concept of quartiles (Note: The original text mentioned "geometric series," but the context and calculation clearly refer to Quartiles Q_1, Q_2, Q_3). In the written answer, the subject first calculated Q_1 (value of the 2nd order data, 54), calculated Q_2 (4th order, 70), and Q_3 (7th order, 78). Thus, it can be concluded that Subject LA met the indicator of presenting concepts in representation, as she was able to show the application of the concept, arrange solution steps sequentially, and produce the final answer independently.

This statement is supported by the interview results below:

Researcher: "How did you solve the story problem about study time earlier?"

Subject LA: "To solve this problem, first I sorted the data from smallest to largest, after that I determined the location of quartiles Q_1, Q_2, Q_3 ."

b. Discussion

Based on the written work and interviews, it can be concluded that Subject LA is capable of applying concepts in problem-solving. This is evident from the ability to sort data and determine quartiles. The subject arranged the solution steps sequentially to produce the final answer independently. This is reinforced by the interview, where the subject asserted solving the calculations without assistance.

This study analyzed the mathematical conceptual understanding ability of Grade VIII students at SMP Negeri 2 Sompak. The test results on 25 students showed ability variations: high, medium, and low categories. Gender disparity might be related to motivation, learning style, or learning experience, emphasizing the need for early identification for learning strategies such as remedial and enrichment. Subject LA, with the highest score, confirmed through interviews that she met all indicators, including calculating mean, median, mode; classifying ratios; applying mean concepts mathematically; and presenting quartiles in sequential representations.

4. CONCLUSION

The mathematical conceptual understanding ability of students on statistics material falls into three categories. Students in the high category are able to restate the concepts of mean, median, and mode, classify data based on measures of central tendency, apply the concept of quartiles mathematically, and present data in representational forms such as bar charts or box plots correctly and sequentially. Students in the medium category sufficiently understand basic statistical concepts but are still hesitant and less meticulous, resulting in incomplete or less accurate answers, such as errors in calculating averages. This indicates that students' mathematical conceptual understanding still varies; thus, teachers need to provide appropriate learning strategies, such as using real daily data, interactive simulations, and intensive guidance so that statistical conceptual understanding can improve evenly.




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