



ANALYSIS OF GRADE XI STUDENTS' DIFFICULTIES IN SOLVING MATH STORY PROBLEMS BASED ON CRITICAL THINKING SKILLS

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ABSTRACT

This descriptive study aims to analyze students' difficulties in solving mathematical word problems based on their critical thinking skills. The study was conducted at SMA Negeri 1 Tanggetada, involving 26 students as research subjects using purposive sampling technique. Several students representing different categories of critical thinking skills were selected for interviews based on their test results. The results showed that, on average, students experienced a 68.97% difficulty level across all indicators, indicating a high category of difficulty. Among the indicators, students had the greatest difficulties in drawing conclusions (93.59%) and performing calculation operations (87.18%). Furthermore, the students' critical thinking skills were found to be very low, with an average score of 10.9.

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1. INTRODUCTION

Mathematics plays a critical role in developing students' logical, analytical, and systematic thinking skills, which are essential in the 21st-century learning context. One of the most challenging question types in mathematics learning is mathematical word problems. Story problems require students to understand the context of the problem, identify relevant information, and translate it into mathematical form to be solved

procedurally. This process not only requires conceptual understanding but also strong critical thinking skills.

However, in reality, many students experience difficulties in solving math word problems. This is consistent with the findings of Jamal (2019), research, which found that 58.34% of students were in the very difficult category, 8.33% were in the difficult category, there are no students in the moderate category, and 33.33% had no difficulty. The difficulties experienced by students are indicated by certain disruptions in achieving learning outcomes, which ultimately result in students' mathematics achievement levels being below what they should be.

According to the 2018 PISA results, Indonesia ranked 73rd out of 79 countries in mathematics, with an average score of 379, far below the OECD (2019), average of 489. Similarly, the 2015 TIMSS results showed Indonesia ranked 44th out of 49 countries, scoring 397 compared to the international average of 500 (Hadi & Novaliosi, 2019). Indonesia is in the bottom 5, indicating that the mathematics achievement of students in Indonesia is relatively low.

Based on the results of research by Hendriana et al., (2017), it was stated that the factor causing students' difficulties in solving story problems was their weak ability to read and understand sentences in the problems. This highlights the need to enhance students' reading comprehension and reasoning in mathematical problem contexts. In this context, critical thinking skills are one of the important aspects that can influence students' success in solving story problems.

Critical thinking enables students to analyze, evaluate, and make reasoned decisions when solving problems, making it essential in mathematics learning. Therefore, the application of mathematical critical thinking skills in learning is very important, as through these skills students can think rationally, determine solutions, and make appropriate decisions based on information (Basri et al., 2019; Basri & As,ari, 2018). In line with this, Hendriana et al., (2017), state that critical thinking involves not accepting information at face value without knowing its source, but rather being able to justify opinions with logical reasoning. Unlike previous studies, this study offers a new approach by linking students difficulties to categories of critical thinking skills, an aspect that has not been widely explored in previous studies.

According to Afifah et al., (2023), there are four main indicators of critical thinking involved in solving math word problems: formulating the main issue, writing down relevant facts, working on the problem with logical answers, and double-checking the answers that have been made. Additionally, Khoirunnisa et al., (2020), emphasize that mathematical word problems can train students to think critically by interpreting information, making decisions, and developing problem-solving strategies. Therefore, it is important to review students' difficulties in solving mathematical word problems based on their level of critical thinking ability. By understanding the relationship between the two, teachers can design more targeted learning strategies, such as developing practice problems that enhance critical thinking skills or providing specialized guidance for

students who are struggling. These indicators serve as the basis for evaluating students' difficulties in this study.

Observations and interviews with Mrs. Marlina, a mathematics teacher at SMA Negeri 1 Tanggetada, revealed that students struggled with mathematical word problems. They often failed to understand the problem content and translate it into mathematical form. This can certainly lead to errors when solving the problems.

In light of the problems described, this study aims to identify students' difficulties in solving mathematical word problems in relation to their critical thinking skills. Therefore, the present study focuses on analyzing students' difficulties in solving mathematical word problems based on their critical thinking abilities.

2. METHOD

This study employed a descriptive qualitative research method with a qualitative approach. Descriptive research aims to explain situations, events, or objects related to variables through descriptions of words (Salahuddin & Saebani, 2017). Research based on postpositivism uses a qualitative approach, focusing on the natural conditions of the object, with one researcher as the primary tool. Data collection processes employ triangulation (combination), data analysis is conducted inductively or qualitatively, and qualitative research findings emphasize meaning over generalization (Sugiyono, 2017). This study was conducted in the second semester of the 2024/2025 academic year from May 22 to May 26 in class XI of SMA Negeri 1 Tanggetada with 26 students. The research subjects were given a critical thinking ability test. Based on the test results, several subjects representing categories of critical thinking ability were selected to participate in follow-up unstructured interviews to explore their difficulties in solving problems in depth. This selection aimed to obtain rich and varied qualitative data representing each category. Furthermore, to measure students' critical thinking skills, adapted from (Riduwan, 2013), is explained in Table 1.

Table 1. Critical Thinking Skills Category

Critical Thinking Skills Category	
Very High	81-100
High	61-80
Moderate	41-60
Low	21-40
Very Low	0-20

source: (Riduwan, 2013)

The determination of the percentage of student difficulty levels is adapted as mentioned by Arikunto in (Kurniasari et al., 2022) using the following formula:

$$P_i = \frac{n}{N} \times 100\%$$

(Kurniasari et al., 2022)

Explanation:

P_i = Presentation of difficulty type i

n = Number of student difficulties in type i

N = Maximum number of difficulties that may occur in type i

The criteria for the percentage of difficulty taken from each type of difficulty, score conversion adapted from Riduwan in Sari (2021), are explained in Table 2.

Table 2. Criteria for the Percentage of Difficulty Students

Percentage	Classification
$80\% < P \leq 100\%$	Very high difficulty
$60\% < P \leq 80\%$	High difficulty
$40\% < P \leq 60\%$	Moderate difficulty
$20\% < P \leq 40\%$	Low difficulty
$0\% \leq P \leq 20\%$	Very low difficulty

Source: (Riduwan dalam Sari, 2021)

3. RESULTS AND DISCUSSION

3.1. Results

3.1.1 Description of Student Critical Thinking Ability Data

Based on the results of the test completed by 26 students, a variety of scores were obtained. The data distribution of students based on critical thinking skills is presented in Table 3 below.

Table 3. Thinking Skills

Value	Frequency	Percentage	Classification
81-100	0	0%	Very High
61-80	2	7,70%	High
41-60	2	7,70%	Moderate
21-40	3	11,53	Low
0-20	19	73,07%	Very Low

Based on Table 3, it can be seen that the results of the critical thinking test showed that 2 students or 7.70% of students were in the high category, 2 students or 7.70% of students were in the sufficient category, 3 students or 11.53% were in the low category, and 19 students or 73.07% were in the very low category. with an overall average score of 10.9 for students in SMA Negeri 1 Tanggetada, indicating that the average critical thinking ability of students in that class is in the very low category.

3.1.2 Description of Student Difficulties in Solving Story Problems

Based on the results of critical thinking tests taken by 26 students in grade XI at SMA Negeri 1 Tanggetada, the researchers classified the students' difficulties in each indicator of difficulty in solving story problems into four categories, namely very high, high, moderate, and low. Descriptive data on the average difficulty of students in solving story problems can be seen in Table 4. below:

Table 4. Average Indicators of Student Difficulty in Solving Story Problems

No	Difficulty Indicators	Percentage (%)	Interpretation
1.	Difficulty Mastering Concepts	55,13	Moderate
2.	Difficulty Using Data	37,18	Low
3.	Difficulty Interpreting Mathematical Language	71,79	High
4	Difficulty in Calculations	87,18	Very high
5.	Difficulty Drawing Conclusions	93,59	Very high
Average		68,79	High

Based on Table 4, it can be seen that there are five indicators of student difficulty in solving the story problems studied. The indicator of difficulty in mastering concepts, with a percentage of 55.13%, shows that it is in the low category, while the indicator of difficulty in using data, with a percentage of 37.18%, shows that it is in the high category. the indicator of difficulty in interpreting mathematical language with a percentage of 71.79%, indicating a high category, the indicator of difficulty in arithmetic operations with a percentage of 87.18%, indicating a high category, and the indicator of difficulty in drawing conclusions with a percentage of 93.59%, indicating a very high category. With an overall average percentage of 68.79% for students' difficulty in solving story problems among 11th grade students at SMA Negeri 1 Tanggetada, this indicates that students' difficulty is in the high category.

3.1.3 Analysis of Difficulties in Solving Story Problems from the Perspective of Critical Thinking Skills

The data collected through critical thinking tests showed varying results. Based on data analysis, students' critical thinking abilities were categorized into four categories: high, moderate, low, and very low. There were 19 students in the very low category, 3 students in the low category, 2 students in the moderate category, and 2 students in the high category. The test results also revealed several difficulties students faced in solving story problems for each indicator, with varying percentages of difficulty: 55.13% for the concept mastery indicator, 37.18% for the data usage indicator, 71.79% for the mathematical language interpretation indicator, difficulty in performing calculations at 87.18%, and difficulty in drawing conclusions at 93.59%. Therefore, from the 26 students, 4 students were selected to represent each criterion of critical thinking ability and student difficulty in solving story problems. Based on the results obtained, follow-up interviews will be conducted with the four research subjects. The results of the interviews with the four students determined the students' difficulties in solving story problems related to statistics, in addition to tests and observations. Through interviews, researchers can determine the accuracy and validity of the students' answers. This is because in tests,

students usually only use one method to solve problems, even though they are capable of solving them in other ways. Through interviews, researchers can determine whether students only master the method written on the answer sheet, or whether they master many other methods, or master other methods with different approaches, or whether they have new methods that are not commonly used or have never been used before.

3.2. Discussion

The results of tests and interviews with 11th-grade students at SMA Negeri 1 Tanggetada show that students have difficulties solving statistical problems due to low critical thinking skills. Data analysis reveals various types of difficulties in solving story problems, along with the percentage for each difficulty indicator. Students categorized as S1, with very low critical thinking skills, struggled with all indicators of difficulty in solving story problems. S2 students with low critical thinking skills faced difficulties in indicators 1, 2, and 4. S3 students with adequate critical thinking skills faced difficulties in indicators 1 (concept mastery) and 5 (drawing conclusions). Additionally, S4 students with high critical thinking skills (S4) still encountered difficulties on indicator 1. The following is a discussion of the results of the data analysis on the difficulties that have been obtained.

3.2.1 Difficulties in correctly mastering concepts

Concept mastery difficulties refer to students' inability to identify and apply appropriate formulas or theorems according to the problem context. Difficulties in mastering concepts occur when students are unable to or mistakenly determine the formula or theorem to answer a question. From the data analysis, it was found that there were 43 types of difficulties in mastering concepts, or 55.13%. For example, students struggled to distinguish between known and asked information, to understand the context, and to select appropriate formulas. These difficulties arise from weak critical thinking, particularly in understanding problems and planning appropriate solutions. This is in line with Anggraini (2021), who states that students' difficulties in mastering concepts are caused by their inability to understand the material well, and students only memorize formulas briefly when they are taught. As a result, students become confused and forget which formula to use to answer questions.

3.2.2 Difficulties in using data

Data usage difficulties occur when students fail to use the relevant data, misplace values in formulas, or include unnecessary information. From the data analysis, it was found that there were 29 types of difficulties in using data, or 37.18%. One example of the difficulties experienced by students is mistakes in entering values into variables or formulas, and students not using the known elements in the question to answer the question "Actually, I'm confused about which data to enter into the formula," said one of the students. Students who have difficulty using data do so because of a lack of critical thinking skills in understanding problems and implementing plans. In line with this, Anggraini (2021), argues that this is because students rush, are not careful in working on questions, are confused about using data, and are unable to complete questions to the end.

In addition, difficulties in using data are caused by students not being careful and not understanding the steps to solve problems well.

3.2.3 Difficulties in interpreting mathematical language

This type of difficulty refers to misinterpreting mathematical symbols or failing to translate narrative sentences into equations. As many as 56 cases (71.79%) were identified, mostly involving failure to convert story sentences into mathematical expressions. One example of the difficulties experienced by students is the difficulty in converting story sentences in questions into mathematical language, and the difficulty in interpreting symbols (\bar{x}) for averages. This reflects weak critical thinking skills in planning and interpreting information logically. This aligns with Jana (2018), view that errors in interpreting mathematical language occur because students do not fully understand the intent of the information provided in the problem and do not comprehend the problem as a whole, leading to misinterpretation.

3.2.4 Difficulties in performing arithmetic operations

Arithmetic difficulties refer to calculation errors and mistakes in algebraic manipulation, such as sign errors or incorrect operations. From the data analysis, it was found that there were 68 types of difficulties in performing arithmetic operations, or 87.18%. One example of difficulties experienced by students is errors in performing arithmetic operations, such as not paying attention to negative and positive notation when performing arithmetic operations. Such errors often result from weak critical thinking when executing problem-solving plans, especially involving large numbers and algebra. Another cause is that students still have difficulty in dividing and multiplying large numbers and lack an understanding of algebra. In line with the opinion of Khoirunnisa et al., (2020), difficulties in calculations arise when students are still confused about whether to reverse formulas or move variable terms. Some students still lack mastery of algebra, and students also struggle with performing operations on large numbers, leading to errors in calculating final values.

3.2.5 Difficulties in drawing conclusions

Conclusion difficulties refer to students' inability to summarize results or finalize problem solutions. From the results of data analysis, the number of types of difficulties in drawing conclusions was 73 or 93.59%. Students who had difficulty in drawing conclusions did so because of a lack of critical thinking skills in the aspect of concluding. Additionally, based on the results of interviews, students were rushed and lacked attention to detail when working on problems, so they did not write down the conclusions from the answers they obtained. This aligns with the opinion Ariyani (2019), that students are not accustomed to and sometimes forget to write down the conclusions of their answers after the problem-solving process is complete. Another cause is that the subject was unable to complete the problem until the end, so they could not draw a conclusion.

Students with higher critical thinking skills experienced fewer difficulties. Conversely, students with low critical thinking faced more challenges. The difficulties experienced by students are in line with the initial observations made by the researcher that one of the difficulties students face in solving story problems is their low critical

thinking skills. The researcher also identified several weaknesses of the students, including: (1) Misunderstanding the question; (2) Failing to distinguish known and asked info; (3) Inaccurate calculation; etc. This is in line with the research conducted by Pirmanto et al., (2020), which concluded that students are not accustomed to solving mathematical problems procedurally in accordance with critical thinking ability indicators. This confirms the finding that students solve problems procedurally without applying critical thinking indicators.

Therefore, when solving problems, students are accustomed to solving them directly without following the established steps. In addition, students tend to memorize formulas, which leads to errors in solving the given problems, and a lack of mastery of prerequisite aspects in infinite geometry also causes students to experience difficulties in solving problems. In line with this, research conducted by Ayu et al., (2021), concluded that difficulties in learning mathematics include understanding concepts, calculation skills, and problem solving. Setiawan (2017), explains that both internal (motivation, interest) and external (home, school) factors contribute to learning difficulties, which were observed in this study.

4. CONCLUSION

The analysis of 26 eleventh-grade students at SMA Negeri 1 Tanggetada showed that their average critical thinking ability was very low, with a mean score of 10.9. The percentage of students experiencing difficulty in each indicator was: concept mastery (55.13%), data usage (37.18%), interpreting mathematical language (71.79%), calculation operations (87.18%), and drawing conclusions (93.59%). Overall, the average difficulty level was high, with a score of 68.97%.

The identified difficulties based on students' critical thinking skills are as follows: (1) In concept mastery, students struggled to determine the appropriate formula and often used formulas in contexts where they were not applicable; (2) In using data, students were confused about how to input known elements into variables or formulas; (3) In interpreting mathematical language, students struggled to translate narrative sentences into mathematical expressions; (4) In performing calculations, students had trouble with large numbers and often ignored signs, leading to computational errors; (5) In drawing conclusions, although some students were capable, they rushed through problems and often failed to write down the final answers.

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