

ERROR ANALYSIS OF CLASS XII STUDENTS OF PUBLIC HIGH SCHOOL 18 MEDAN IN SOLVING OPPORTUNITY PROBLEMS

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ABSTRACT

This study aims to analyze the errors made by students in understanding the material of probability and the factors that cause it. With a qualitative descriptive approach, the subjects of the study were students of class XII of SMA Negeri 8 Medan. Data were collected through tests which were then analyzed through the process of data reduction, data presentation, and drawing conclusions. The results showed that the type of error in writing the final answer (encoding error) dominated with a percentage of 66.66%, followed by process skill errors (process skill) 60.09%, transformation errors (transformation error) 54.28%, errors in understanding questions (understanding errors) 52.38%, and errors in reading questions (reading errors) 20.95%. These errors are caused by students' inability to interpret the questions and the tendency to rush, which results in a lack of accuracy. This study suggests that teachers develop learning methods that emphasize reading and process skills, and involve students in discussions to improve their understanding and skills in solving probability questions.

Keywords: analysis; error; opportunity; story questions.

ABSTRAK

Penelitian ini bertujuan untuk menganalisis kesalahan yang dilakukan siswa dalam memahami materi peluang serta faktor penyebabnya. Dengan pendekatan deskriptif kualitatif, subjek penelitian yang digunakan adalah siswa kelas XII SMA Negeri 8 Medan. Data dikumpulkan melalui tes yang kemudian dianalisis melalui proses reduksi data, penyajian data, dan penarikan kesimpulan. Hasil penelitian menunjukkan bahwa jenis kesalahan dalam menuliskan jawaban akhir (encoding error) mendominasi dengan persentase 66,66%, diikuti oleh kesalahan keterampilan proses (process skill) 60,09%, kesalahan transformasi (transformasi error) 54,28%, kesalahan memahami soal (comprehension error) 52,38 %, dan kesalahan membaca soal (reading error) 20,95%. Kesalahan ini disebabkan oleh ketidakmampuan siswa dalam memaknai soal serta kecenderungan untuk terburu-buru, yang mengakibatkan kurangnya ketelitian. Penelitian ini menyarankan agar guru mengembangkan metode pembelajaran yang menekankan pada keterampilan membaca dan proses, serta melibatkan siswa dalam diskusi untuk meningkatkan pemahaman dan keterampilan mereka dalam menyelesaikan soal peluang.

Kata Kunci: analisis; kesalahan; peluang; soal cerita.



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Introduction

Mathematics is one of the most important subjects in education because it is the basis for many other disciplines, and also plays a major role in everyday life, especially in improving critical thinking, analytical, and problem-solving skills. One branch of mathematics that has wide application is probability, which is a concept used to determine the likelihood of an event occurring, both in everyday life and in various fields of science. According to Sholekah, Anggreini, and Waluyo (2017), one of the most significant challenges that students face while solving mathematical issues is their inability to connect concepts to solve story problems. Probability is a subject of mathematics that is widely applied. It is a concept used to determine the possibility of an event occurring in everyday life as well as in other sectors of science. Probability is significant in many domains, including economics, health, engineering, and computer science, where a solid understanding of chance can aid decision making (Zainudin, 2023).

Several previous studies have shown that many students have difficulty understanding the concept of probability and solving challenges involving this subject. Graciella and Suwaningsih (2016) and Dewimarni (2017) stated that mathematics is very important in solving difficulties in everyday life, but students' understanding of probability is still lacking. According to Rasyid (2017) and Somawati (2018), students' capacity to think logically and methodically may be negatively affected by poor understanding of mathematics. Most students make mistakes when dealing with probability problems because they do not understand the basics, they use formulas incorrectly, and they make calculations incorrectly (Sulaiman, 2024).

Many previous studies have focused on the errors that students make when trying to solve probability problems. Komarudin (2016) identified a number of common errors, including misinterpreting the problem, difficulty translating problem data into mathematical form, using formulas incorrectly, performing calculations incorrectly, and making mistakes when providing final answers. These errors indicate that more research is needed to fill the gaps in the learning process. Furthermore, Indriani's (2020) research found that students made mistakes when solving story problems on probability material, such as not writing down what they knew from the problem, using inappropriate formulas, not practicing enough with different types of problems, and not being careful when calculating. Citra, Rahmawati and Vahlia (2022) Student error analysis is used to determine what appropriate actions teachers should take for their students.

Saparwadi (2023) also discovered that students frequently make mistakes when understanding mathematical problems in the form of story problems, such as being less careful in understanding the problem, being unable to think recursively, and failing to draw analogies from the information obtained, which causes difficulties in the solution process. Meanwhile, Nababan et al. (2023) discovered that grade VIII junior high school students made a variety of errors when solving probability questions based on Watson's criteria, including erroneous data, inappropriate techniques, missing data, and missing conclusions.

Tanzimah and Sutrianti (2023) found that students frequently make mistakes when reading questions (61.90%), understanding problems (23.80%), transformation (55.95%), process skills (53.57%), and writing final solutions

(67.85%). These inaccuracies suggest that more study is required to address the gaps in the learning process. Furthermore, Aini and Saputro (2023) discovered that students made mistakes in planning, implementing strategies, and checking back when completing story problems based on probability content. This study underlines the significance of a thorough understanding of the steps of problem solving in order to prevent student errors. Furthermore, Zalfa and Rahmawati (2024) demonstrated that students made mistakes in the stages of comprehending (50%), concluding responses (22.85%), process skills (18.57%), transformation (4.29%), and reading (4.29%) when answering story problems using statistics material. These errors are caused by a lack of mathematical literacy abilities, the practice of directly calculating without writing down the facts known and requested, and inaccuracies in performing arithmetic operations.

The expected learning outcomes of the curriculum have not been fully met because students still make mistakes when trying to solve probability problems. Therefore, to create a more effective learning strategy, a thorough investigation is needed into the types of errors that often occur and the reasons that cause them. Teachers can create more effective teaching strategies to help students understand the concept of probability by analyzing student error patterns.

The purpose of this study was to determine the common errors made by grade XII students of SMA Negeri 18 Medan when trying to solve probability problems. This study also aims to examine the variables that influence these errors and offer suggestions for teaching methods that can improve students' understanding of probability. It is hoped that the findings of this study will help in the creation of more efficient mathematics teaching strategies and assist students in overcoming their challenges with probability.

Research Methods

This research uses a qualitative descriptive approach to understand in depth about where and how student errors lie in understanding opportunity material and the factors that cause student errors. (Nazir, 2019) states that descriptive method is a method used to investigate an object, individual, class thought, or condition. The subjects in this study were XII grade students of SMA Negeri 18 Medan with a research sample of 35 students.

The research instrument used in this study was a test. This test was designed to measure students' difficulties in working on chance problems. In this research conducted, the data collection technique used was a test. This test was given individually and asked students to complete it. According to (Sugiyono, 2011), the following stages of analysis were used to analyze the data of this study: (1) *Reducing Data*; reducing data by prioritizing important aspects. By selecting the work done by students who made mistakes, then the data in this study were reduced. Furthermore, the researcher placed student errors into categories based on error indicators. The percentage of student errors in various forms including 1) reading errors, 2) transformation errors, 3) process skills errors, and 4) errors in understanding the problem. (2) *Data Presentation*: This research data is presented in tabular form with percentages sorted by error type, and (3) *Drawing Conclusions*: Re-analysis of the data that has been analyzed based on the type of error is carried out to obtain conclusions. The data collected from the test results were analyzed

qualitatively, with steps such as: 1) examination of test results, students' answers were examined and assessed; 2) identification of error patterns, students' answers were analyzed to identify patterns of errors commonly made by students; 3) categorization of errors, the errors found were grouped into certain categories based on the types of errors or concepts that students did not understand; and 4) interpretation of data, the data were interpreted to understand why students made these errors.

Results and Discussion

Based on the results of the analysis of student answers that have been carried out, the percentage of errors based on the type of error is shown in Table 1 below:

Table 1. Percentage of Student Error

No	Error Type	The amount of students who answered the questions incorrectly			Total	Percentage
		No. 1	No. 2	No. 3		
1	Reading question	2	11	8	22	20,95%
2	Understanding question	18	32	5	55	52,38%
3	Transformation	18	32	7	57	54,28%
4	Process skills	21	31	12	64	60,09%
5	Final writing	12	32	26	70	66,66%
Average					53,6	50,78%

Based on Table 1 above, the results of the analysis show that Encoding error, namely errors in writing the final answer is the most frequent type of error, with a percentage of 66.66%. This shows that most students face difficulties in writing the final answer to the story problem on the probability material.

In addition, Process Skill Error, namely process skill errors with a percentage of 60.09%, which shows that most students have difficulty solving problems according to accurate procedures. Transformation error, namely transformation errors with a percentage of 54.28%, shows that students have difficulty transferring information from story problems into mathematical models. Information transfer consists of planning a solution strategy, implementing it, and evaluating the solutions obtained.

The results of the analysis show that Comprehension Error, namely errors in understanding questions with a percentage of 52.38%. This shows that students have difficulty understanding the information in story problems. Therefore, the interpretation of information made by students is less accurate. Reading Error, namely errors in reading questions, with a low percentage of 20.95%. This shows that students have difficulty identifying the use of appropriate mathematical words or terms according to story problems in the material on probability. However, it is important for teachers to see students' ability to understand the context and meaning of the problems in story problems. This is in line with the results of a study conducted by Rasyid (2017) which found that around 45% of students have

difficulty understanding mathematical story problems due to a lack of understanding of the terms and language structures used. This indicates that language comprehension also plays an important role in students' ability to solve probability problems. Thus, the use of visual media or contextual aids can be a solution to improve student understanding.

The following is a description of the analysis of students' answers in solving problems with the type of error in the form of errors in understanding the problem. Answer of Student 1 is shown in Figure 1 below:

Handwritten mathematical solution for Student 1:

$$\begin{aligned} 1. \quad n(S) &= 500 \\ n(A \cup B) &= n(A) + n(B) - n(A \cap B) \\ 900 &= 375 + 275 - n(A \cap B) \\ n(A \cap B) &= 650 - 900 \\ n(A \cap B) &= 150 \\ P(A \cap B) &= \frac{n(A \cap B)}{n(S)} \\ &= \frac{150}{500} \\ &= \frac{3}{10} \end{aligned}$$

Figure 1. Answer of Student 1

Based on Figure 1, there are reading errors in the answers to the questions. Students fail to understand the information and instructions in the questions and cannot understand the sentences. To reduce reading errors, teaching strategies that focus more on improving students' reading skills should be applied. This includes providing intensive reading exercises, improving contextual understanding, and expanding mathematical vocabulary. To ensure that information about the story is well understood by students, it is very important to provide clear guidance. By using video media containing examples of practice questions, learning is carried out according to students' needs, namely, helping students overcome reading difficulties and improving understanding and solving story problems on the material of probability. Answer of Student 2 is shown in Figure 2 below:

Handwritten mathematical solution for Student 2:

$$\begin{aligned} 1. \quad n(S) &= 500 \\ n(A \cup B) &= n(A) + n(B) - n(A \cap B) \\ 900 &= 375 + 275 - n(A \cap B) \\ n(A \cap B) &= 650 - 900 \\ n(A \cap B) &= 150 \\ P(A \cap B) &= \frac{n(A \cap B)}{n(S)} \\ &= \frac{150}{500} \\ &= \frac{3}{10} \end{aligned}$$

Figure 2. Answer of Student 2

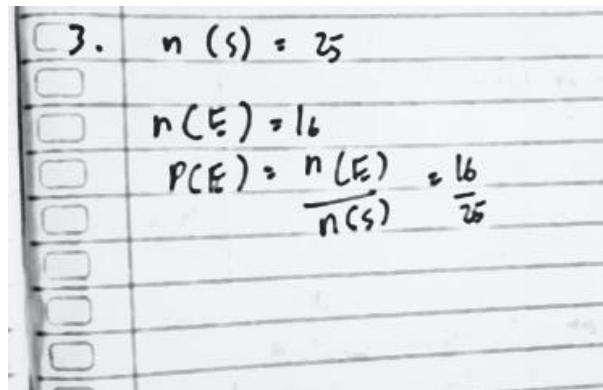
Based on Figure 2, reading errors were found in the answers to the questions. Students failed to understand the information and instructions in the questions and could not understand the sentences. To reduce reading errors, teaching strategies that focus more on improving students' reading skills should be applied. This includes providing intensive reading exercises, improving contextual understanding, and expanding mathematical vocabulary. To ensure that information about the story is well understood by students, it is very important to provide clear guidance. With a method combined with using video media containing examples of practice questions, learning is in accordance with students' needs, namely to help overcome reading difficulties and improve understanding and solving story problems on probability material. Answer of Student 3 is shown in Figure 3 below:

Handwritten mathematical work on lined paper. The work is as follows:

$$2. \quad n(s) = 6^4$$
$$P_{1:1:3:1}^4 = \frac{4!}{1! \times 3!} = 4$$
$$P_{1:1:1:4}^4 = \frac{4!}{1! \times 1! \times 1! \times 2!} = 12$$
$$P_{1:1:3:1}^4 = \frac{4!}{1! \times 3!} = 4$$
$$n(E) = 4 + 12 + 4 = 20$$

Figure 3. Answer of Student 3

Based on Figure 3 above, it was found that the error made by student II was an error in understanding the question. Because, students immediately solve the problem by writing the formula directly without including the information known and asked in the question. After studying the information from the interview, it was found that the tendency of students to be too hasty in solving the question causes a misunderstanding of the problem. Students often make this misunderstanding because they do not present the information they know and that is asked in the question in their answers. To solve this problem, teachers must be able to train students to read questions carefully. Students must be taught to identify information contained in the question, both from the information known and the information asked. In addition, it is very important for students to have the opportunity to discuss with fellow friends and share what they know about the questions given so that students can share knowledge and see different perspectives. Students are expected to be more careful in describing relevant information as an improvement in understanding the problems presented. Answer of Student 4 is shown in Figure 4 below:



3. $n(S) = 25$
 $n(E) = 16$
 $P(E) = \frac{n(E)}{n(S)} = \frac{16}{25}$

Figure 4. Answer of Student 4

Based on Figure 4 above, it was found that students made errors in transforming questions into mathematical models. These errors occurred because students were not careful in working on questions at the transformation stage.

From the errors made by students, it can be concluded that students experienced errors in process skills. Students do not have the ability to transform data into the right mathematical model. This error indicates that students do not understand the process needed to solve story problems. To avoid this error, a more focused approach should be used to teach students to use process skills. Teachers can conduct exercises that focus on the transformation phase, by teaching students how to transform data into appropriate mathematical models.

Based on the results of the analysis of the answers of class XII students of SMA Negeri 18 Medan in solving probability problems, several types of errors were found that often occur. These errors are categorized based on their type, namely errors in reading questions, errors in understanding questions, errors in transformation, errors in process skills, and errors in final writing. Students' errors in reading questions cause students to have difficulty in understanding the questions. This is in line with the findings of Graciella and Suwaningsih (2016) who stated that many students still have difficulty in reading questions on the concept of probability, so that the solutions to the questions worked on by students are not correct.

Misunderstanding of questions occurs when students misunderstand the meaning of the question and translate it into the correct mathematical model. Some students have difficulty identifying important information in the question, which leads to errors in solving. Rasyid (2017) and Somawati (2018) stated that poor understanding of mathematics as a whole can have a negative impact on students' logical thinking skills, which is also seen in this study. Mistakes in transformation and process skills errors lead to incorrect final answers. Calculation errors, such as errors in basic operations such as addition, multiplication, and division, are also often found. Sulaiman (2024) also revealed that students often experience obstacles in calculations because they are not careful in operating numbers, resulting in incorrect answers. Final writing errors are certainly caused by inappropriate solutions made by students. Dewimarni (2017) stated that many students still have a poor understanding of the concept of probability, which results in errors in solving questions.

This study was limited to grade XII students of SMA Negeri 18 Medan so that the results cannot be generalized to a wider population. This study has not explored in more depth the factors that cause these errors, such as students' academic backgrounds or teaching methods applied by teachers. However, based on the results of the error analysis above, this study has succeeded in identifying various types of student errors comprehensively in solving probability problems systematically, starting from conceptual understanding to calculation skills. The results of this study are in line with previous studies, such as Graciella and Suwaningsih (2016), Dewimarni (2017), and Sulaiman (2024), which stated that understanding the concept of probability is still an obstacle for many students. The findings of this study can be used to develop more effective learning strategies in learning mathematics on probability material.

Based on the results of this study, it can be said that errors in solving probability problems are not just a matter of mathematical skills, but are also related to how students process information. When students face probability problems, they must first read and understand the information given. If they fail at this stage (as seen from the 20.95% reading error in the problem), then the next errors will be in a row. Information that is not well understood will be difficult to translate into the correct mathematical model, thus triggering transformation errors (54.28%). Errors in this transformation ultimately have an impact on process skills (60.09%) and errors in writing the final answer (66.66%).

In this context, the results of the study indicate a clear cause-and-effect relationship. Reading errors lead to misunderstandings of the problem, which then lead to transformation errors and incorrect solution processes. As a result, the final answers given by students are also incorrect. This finding also strengthens the argument that mathematics education should be more than just teaching formulas. Students need to be trained to think logically and understand the context of the problem in depth. Therefore, teachers can apply more interactive learning methods, such as group discussions or the use of visual media to improve student understanding.

From the results of this study, it can be concluded that students' errors in solving probability problems do not occur randomly, but have a clear and recurring pattern. Therefore, by understanding this error pattern, teachers can design more effective strategies to overcome obstacles to students' understanding of the concept of probability.

As for suggestions for further research, it is carried out with a wider scope, both in terms of the number of samples and the location of the school, to obtain more general results, further research should explore the factors that influence students' errors in solving probability problems, such as the influence of teaching methods, levels of math anxiety, or student learning strategies. Future research can develop and test the effectiveness of learning strategies designed to reduce student errors, such as technology-based approaches or problem-based learning models. Long-term research can be conducted to monitor changes in error rates over time after learning interventions are implemented.

Conclusion and Suggestion

Based on the research that has been done, it can be concluded that students make many mistakes in writing the final answer is a type with a percentage of 66.66%, process skill errors have a percentage of 60.09%, errors in transformation of 54.28%, errors in understanding the problem have a percentage of 52.38% and errors in reading the problem of 20.95%. This is caused by students' tendency to solve problems quickly which causes students to be less careful and do not record known and questionable information in the problem. As a result, students lack accuracy when working on problems given by the teacher.

Suggestions in this study, it is hoped that after knowing the types of errors made by students, teachers can use the results of this study as evaluation material to help teachers improve learning in the classroom. Teachers should improve approaches that focus more on improving students' reading skills and their processes in opportunity materials. In addition, it is important for teachers to be able to provide practice problems that require students to read problems, discuss problems, and share information about students' understanding of problems to gain different insights and perspectives.

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