



## An Analysis of Grade XI Students' Errors in Solving Statistical Problems Based on Newman Error Analysis (NEA) Theory

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### ABSTRACT

Students' errors in solving statistics problems indicate that their mathematical problem-solving abilities have not yet developed optimally, particularly in understanding problems, transforming them into mathematical models, and communicating final answers. This study aims to analyze the errors made by grade XI students in solving statistics problems based on Newman Error Analysis (NEA). This research employs a qualitative descriptive approach with a sample of 30 grade XI students from a senior high school in Praya during the 2025/2026 academic year. The research instruments consist of two contextual essay questions on statistics, supported by interviews and documentation. Data analysis follows the Miles and Huberman model, which includes data reduction, data display, and conclusion drawing. Student errors are classified into five stages of NEA: reading, comprehension, transformation, process skills, and encoding errors. The results show that errors occur at all stages of NEA, with transformation errors (24.12%) and encoding errors (27.05%) being the most dominant, followed by process skills errors (23.56%), comprehension errors (20.59%), and reading errors (0.59%). Transformation errors indicate students' difficulties in converting contextual information into appropriate mathematical forms, while encoding errors show that students are not yet able to clearly communicate their final answers. These findings suggest the need to strengthen conceptual understanding, problem transformation skills, computational accuracy, and mathematical communication. Therefore, teachers need to implement instructional strategies that emphasize conceptual understanding, the use of multiple representations, and the practice of writing conclusions systematically. Future research is recommended to involve a larger sample and examine the effectiveness of instructional interventions.

Keywords: student error; statistics; Newman Error Analysis; problem solving

### INTRODUCTION

Students' errors in solving mathematical problems are a common phenomenon encountered in the learning process at school. These errors do not only occur at the computational stage, but also in understanding the problem, determining solution strategies, and writing the final answer (Hadaming & Wahyudi, 2022). This indicates that students' problem-solving abilities have not yet developed optimally. In fact, problem-solving ability is one of the essential competencies in mathematics learning, as it can develop students' logical, critical, and analytical thinking skills (Sofiyah et al., 2025). herefore, mathematics instruction should not only focus on obtaining the correct final answer, but also emphasize conceptual understanding and the thinking processes involved in solving various problems related to real-life situations (Sari et al., 2023). This problem-solving ability serves as an important indicator of the success of the learning process, as it reflects students' deep conceptual understanding.

The low level of students' mathematical problem-solving ability in Indonesia is reflected in the results of the 2022 PISA assessment. The data indicate that Indonesia's mathematics score reached 366, which remains far below the OECD average of 472 (OECD, 2023). These results suggest that many students still experience difficulties in understanding contextual mathematical problems, interpreting the given information, and determining appropriate solution strategies. Safari & Putri (2024) state that difficulties in learning mathematics are generally caused by students' limitations in understanding basic concepts, recalling mathematical facts, and accurately applying computational procedures. These difficulties often lead students to make various errors in the process of solving mathematical problems.

Students' problem-solving skills are not sufficiently evident in practical subjects such as statistics. Statistical topics present a considerable challenge because they combine conceptual and procedural elements and require data interpretation skills (Nugraha & Basuki, 2021). Topics such as mean, mode, median, data presentation, and distribution are closely related to everyday life. Empirical evidence shows that many students experience difficulties in understanding statistical concepts and translating word problems into accurate mathematical models. Amalia & Hadi (2021) found that students often struggle to translate real-world situations into appropriate mathematical models, select the correct formulas, and perform calculations accurately. These challenges also arise when students organize information into tables or graphs (Nugraha & Basuki, 2021), transform problems into mathematical models (Latifah & Afriansyah, 2021), choose appropriate solution methods, and draw conclusions (Schunk & DiBenedetto, 2022). Such difficulties tend to result in recurring and persistent errors.

This is consistent with the findings of Sumartini & Safitri (2022) which show that junior high school students make various errors in solving word problems on systems of linear equations in two variables, particularly at the transformation stage, namely converting problem information into an appropriate mathematical model. The errors include misunderstandings of the problem, incorrect selection of solution procedures, computational errors, and inaccurate presentation of final answers. The main factors contributing to these difficulties are students' limited abilities in understanding, representation, and making connections among mathematical concepts, which cause these errors to be systematic and repetitive (Sumartini & Safitri, 2022).

To gain a deeper understanding of students' errors, a systematic analytical method is required one that not only identifies errors in general but also determines the specific stage of the problem-solving process at which the errors occur. One approach that can be used is Newman Error Analysis (NEA). Developed by Newman in 1977, this framework outlines five stages in the problem-solving process: (1) reading errors, (2) comprehension errors, (3) transformation errors, (4) process errors, and (5) encoding errors (Hadi, 2021). Through the analysis of errors at each of these stages, educators can more precisely identify the sources of students' difficulties, whether they stem from reading skills, conceptual understanding, strategy formulation, computational ability, or accuracy in expressing the final answer.

Various previous studies have examined students' errors in solving mathematical problems across different topics. Samosir et al. (2024) found that students made errors in solving problems on linear equations due to misunderstandings of the underlying concepts.

Another study by Labibah et al. (2021) also identified several types of errors frequently made by students in solving word problems involving fractions. However, most of these studies focus on algebraic or arithmetic topics, while research that specifically analyzes students' errors in solving statistical problems using the Newman Error Analysis (NEA) framework remains relatively limited. In fact, error analysis in statistics is important for understanding students' difficulties in interpreting data and applying statistical concepts accurately.

Therefore, this study aims to analyze the errors made by eleventh-grade students in solving statistical problems and to identify the causes of these errors based on the stages of Newman Error Analysis (NEA).

## RESEARCH METHODS

This study employs a qualitative descriptive approach aimed at identifying and describing the types of errors made by students in solving statistical problems based on the stages of Newman Error Analysis (NEA). This approach is chosen to obtain a deeper understanding of students' thinking processes as well as the factors that contribute to errors in solving mathematical problems.

The analysis of students' errors in this study refers to the NEA stages, which include reading errors, comprehension errors, transformation errors, process skills errors, and encoding errors. Each stage is used as an indicator to classify the errors that arise during the problem-solving process. Students' errors will be evaluated according to the NEA framework, which includes the following indicators:

Table 1. Types and Indicators of Newman Error Analysis (NEA)

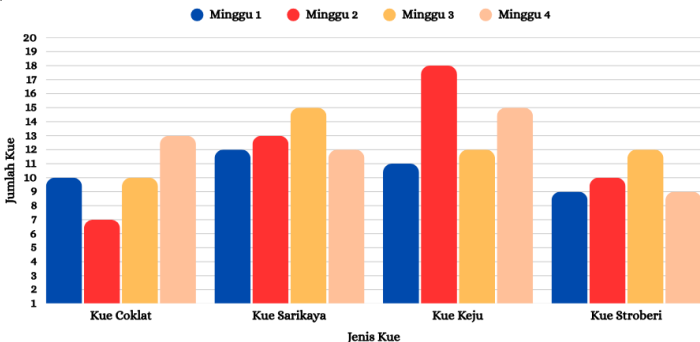
Error Types	Indicator
Reading Errors	Students have difficulty understanding the meaning of words, symbols or numbers that are keywords in the questions
Comprehension Errors	<ol style="list-style-type: none"> <li>1. Students are unable to correctly identify or write down what is known in the problem</li> <li>2. Students are unable to correctly identify or write down what is asked in the question</li> <li>3. Students fail to understand the context or situation described in the question</li> </ol>
Transformation Errors	<ol style="list-style-type: none"> <li>1. Students can't/mistakenly convert story problems into mathematical form correctly</li> <li>2. Students can't/make mistakes in changing the information obtained from the questions</li> <li>3. Students write the wrong method of solving the problem</li> <li>4. Students make mistakes in determining the correct formula</li> </ol>
Process Skill Errors	<ol style="list-style-type: none"> <li>1. The student is unable to perform the procedure that will be used to solve the problem</li> <li>2. Students make mistakes in doing calculations</li> <li>3. Students do not write down and explain the calculation stages correctly</li> </ol>
Encoding Errors	<ol style="list-style-type: none"> <li>1. Writing notation incorrectly</li> <li>2. Misuse of units</li> <li>3. Students do not write down conclusions</li> </ol>

Error Types	Indicator
	4. Students write down conclusions but do not correspond to the results of the final calculation obtained or write according to the results of incorrect calculations

This study focuses on a group of 30 grade XI students from a senior high school located in Praya during the 2025/2026 academic year. Data were collected through tests, interviews, and documentation.

The test instrument consisted of two contextual essay questions on statistical topics, designed to explore students' thinking processes in depth. Each question was carefully constructed to include multiple stages of solution, allowing the researcher to identify various types of errors made by students based on the stages of Newman Error Analysis. Thus, although the number of questions used was relatively limited, each item provided sufficient information to analyze students' thinking processes and to identify the types of errors that occurred during problem-solving. The specific statistical questions designed to highlight student errors were as follows:

Table 2. Statistical Description Test Questions

Question Number	Question																									
1.	<p>In the context of the 80th Indonesian Independence Day, SMAN 1 Praya held a selection of Paskibra candidates who will serve at the flag ceremony on August 17. One of the stages of selection carried out is the measurement of the height of all students who take part in the paskibra extracurricular. Note: height is measured in integers. The measurement data is presented in the following frequency distribution table:</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Height (cm)</th> <th>Many Students</th> </tr> </thead> <tbody> <tr> <td>147-151</td> <td>15</td> </tr> <tr> <td>152-156</td> <td>35</td> </tr> <tr> <td>157-161</td> <td>28</td> </tr> <tr> <td>162-166</td> <td>24</td> </tr> <tr> <td>167-171</td> <td>10</td> </tr> <tr> <td>172-176</td> <td>8</td> </tr> </tbody> </table> <p>The committee conducts selection in several stages. The first stage is related to height. The selection committee's policy, the committee stipulates that only participants with a minimum height of at least three quartiles will qualify for the next stage. What is the minimum height that must be achieved in order to enter the next selection?</p>	Height (cm)	Many Students	147-151	15	152-156	35	157-161	28	162-166	24	167-171	10	172-176	8											
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172-176	8																									
2.	<p>A pastry shop called "Sweet Bakery" has been in operation for several years. To increase customer satisfaction and optimize stock. The store owner routinely records the number of sales of each type of cake every week. The following is the data on cake sales for the last four weeks:</p>  <table border="1" style="margin-left: auto; margin-right: auto;"> <caption>Data for Kue Sales Chart</caption> <thead> <tr> <th>Jenis Kue</th> <th>Minggu 1</th> <th>Minggu 2</th> <th>Minggu 3</th> <th>Minggu 4</th> </tr> </thead> <tbody> <tr> <td>Kue Coklat</td> <td>10</td> <td>7</td> <td>10</td> <td>13</td> </tr> <tr> <td>Kue Sarikaya</td> <td>12</td> <td>13</td> <td>15</td> <td>12</td> </tr> <tr> <td>Kue Keju</td> <td>11</td> <td>18</td> <td>12</td> <td>15</td> </tr> <tr> <td>Kue Stroberi</td> <td>9</td> <td>10</td> <td>12</td> <td>9</td> </tr> </tbody> </table>	Jenis Kue	Minggu 1	Minggu 2	Minggu 3	Minggu 4	Kue Coklat	10	7	10	13	Kue Sarikaya	12	13	15	12	Kue Keju	11	18	12	15	Kue Stroberi	9	10	12	9
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Kue Stroberi	9	10	12	9																						

Question Number	Question
a.	Of the four types of cakes above, which two types of cakes have been the most stable in sales over the past 4 weeks? Explain your reasons based on the change in sales from week to week.
b.	In week 5, the store owner plans to give a 5% discount on cheesecakes. This discount is expected to increase sales by 40% over the previous week. How much cheesecake should you prepare? Consider the effect of discounts on demand. Describe the approach you use.

Interviews were conducted to explore the causes of students' errors, particularly when discrepancies were found between the written solution steps and the expected answers. Documentation was used to obtain supporting data, including students' answer sheets and interview notes.

Data analysis in this study employed the qualitative data analysis model proposed by Miles and Huberman, which consists of three stages: data reduction, data display, and conclusion drawing. In the data reduction stage, students' responses were analyzed and categorized based on the error indicators in Newman Error Analysis. In the data display stage, the results of the analysis were organized systematically to facilitate interpretation. The final stage, conclusion drawing, was conducted to explain the patterns of students' errors and the factors influencing their difficulties in solving statistical problems.

The validity of the data in this study was ensured through technique triangulation, by comparing data obtained from tests, interviews, and documentation. Students' work was first analyzed to identify the types of errors, followed by interviews to confirm and explain the causes of these errors. The comparison of data from multiple sources aimed to enhance the credibility and accuracy of the research findings. Furthermore, the data were presented by describing students' errors at each stage based on Newman Error Analysis. Conclusions were drawn by elaborating on the findings as answers to the research questions formulated in this study.

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

Information:

P = Percentage of student errors for each indicator

n = Number of students who made errors in each specific indicator

N = Total number of student errors across all indicators

## RESULTS AND DISCUSSION

The analysis of students' errors in this study was conducted based on the stages of Newman Error Analysis, which include reading errors, comprehension errors, transformation errors, process skills errors, and encoding errors. This analysis aims to identify in detail the types of errors made by each student in solving the given statistical problems.

The results of the analysis of 30 students' responses indicate that most students made more than one type of error within a single problem. This finding suggests that students' errors in solving statistical problems do not occur at only one stage of the problem-solving process, but may occur sequentially from the reading stage to the stage of writing the final

answer. After identifying the errors made by each student, the next step was to calculate the frequency of errors at each stage of Newman Error Analysis. The recapitulation of these errors is presented in Table 3.

Table 1. Recapitulation of Student Errors

Nomor Soal	Reading Errors (R)	Comprehension Errors (C)	Transformation Errors (T)	Process Skills Errors (P)	Encoding Errors (E)
Soal 1	1	17	23	19	23
Soal 2	0	18	24	22	23
Jumlah	1	35	47	41	46
Persentase	0,59%	20,59%	24,12%	23,56%	27,05%

Based on the recapitulation of students' errors at each stage of Newman Error Analysis, it was found that transformation errors were the most dominant, with a total of 47 errors (24.12%). This was followed by encoding errors with 46 errors (27.05%), process skills errors with 41 errors (23.56%), and comprehension errors with 35 errors (20.59%). Meanwhile, reading errors were the least frequent, occurring only once (0.59%). To provide a clearer illustration of the distribution of students' errors, the data are also presented in graphical form in Figure 1.

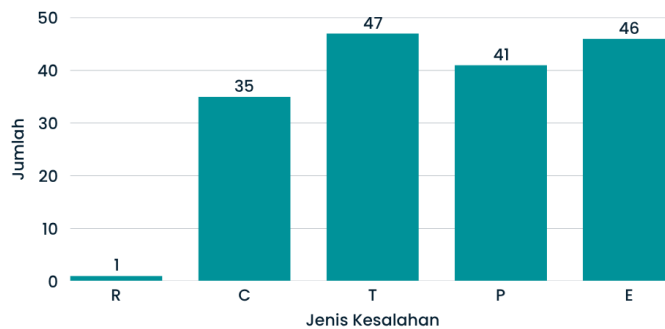


Figure 1 Recapitulation of Student Errors

Based on Figure 1, it can be observed that encoding errors and transformation errors are the most dominant types of errors. This indicates that students experience difficulties in writing complete final answers and in determining appropriate mathematical models that correspond to the given problems.

The analysis of the responses from 30 students also shows that most students made more than one type of error within a single problem. This suggests that students' errors are sequential in nature and may occur across multiple stages in the problem-solving process.

In addition to identifying the types of errors made by students, this study also analyzed students' responses in solving the two given problems. The distribution of student responses is presented in Table 4.

Table 4. Distribution of Student Responses

Response Category	Number of Students
Answered both questions correctly	1
Correct only on question 1	2
Correct only on question 2	3
Did not answer question 2	4
Incorrect on both questions	20

Based on Table 4, it can be observed that only one student was able to answer both questions correctly, while the majority of students were unable to provide correct answers to either question. This indicates that students' ability to solve contextual statistical problems remains relatively low.

**Discussion of Errors Based on the Stages of Newman Error Analysis**

**Reading Errors**

Reading errors represent the initial stage in Newman Error Analysis and are related to students' ability to read and recognize the information presented in a problem. Reading errors occur when students experience difficulties in understanding mathematical terms or statistical symbols contained in the problem. Harini et al. (2025) dan Sumartini & Safitri (2022) suggest that mathematical literacy skills greatly influence students' success in solving word problems or contextual problems.

In this study, reading errors showed the lowest frequency, accounting for only 1 case (0.59%) of the total identified errors. Although the occurrence is minimal, errors at this stage still require attention, as misreading information from the outset can trigger a chain of errors in subsequent stages. An example of a reading error made by a student can be seen in Figure 2.

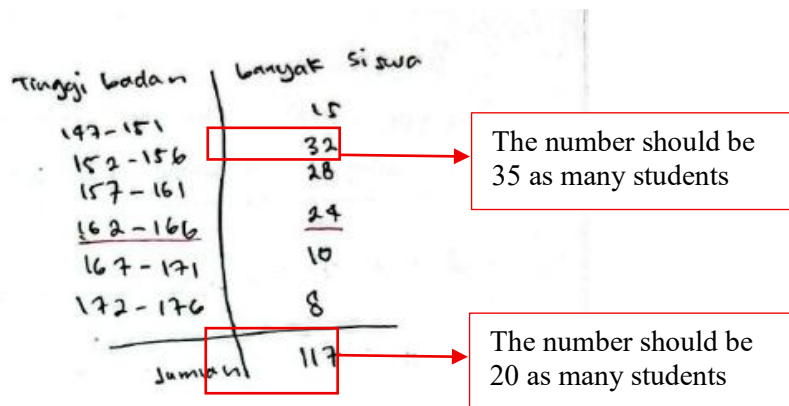


Figure 2. Answer to Question 1 for S13 Students

In Figure 2, it can be seen that Student S13 made an error in reading the data from the frequency distribution table. S13 recorded the number of students with heights of 152–156 cm as 32, whereas the correct value stated in the problem was 35. This error in transcribing information led to incorrect subsequent calculation steps. As a result, the final answer became inaccurate, even though the computational procedure applied was correct.

The results of the interview revealed that this error occurred because the student read the problem hastily and did not recheck the data that had been written down. The student was also unaware that the recorded number differed from the original data in the problem. This finding indicates that a lack of carefulness in reading information is one of the factors contributing to errors at the initial stage of problem-solving. This tendency reflects a common habit among students, namely starting the task quickly without ensuring the accuracy of the initial data.

The findings of this study show that reading errors are often related to the process of transcribing data from frequency distribution tables. Statistical problems involving numerical data in tabular form require a high level of accuracy in reading each value

presented. This is consistent with the findings of Rismawati & Asnayani (2019), who reported that students frequently misread information due to rushing and failing to verify their work. When students do not read information carefully, the data used in calculations become inconsistent with the problem conditions, which in turn affects subsequent solution steps. This is supported by Obeng et al. (2024), who stated that when students misread symbols or words in a problem, they are unable to answer the question as required.

Although reading errors have the lowest frequency, their potential impact is substantial. Rahmayanti & Maryati (2021) emphasize that errors at the initial stage can influence students' entire problem-solving process. Student S13 demonstrated adequate reading ability; however, a lack of awareness regarding the importance of double-checking led to this error being overlooked. This suggests that instructional strategies should explicitly train students to verify data before proceeding to the next stage. Therefore, students need to be habituated to read problems more carefully and to rewrite the given information accurately before beginning the calculation process.

### Comprehension Errors

Comprehension errors refer to students' inability to accurately identify the given information in a problem, determine what is being asked, and understand the context or situation described. In this study, there were 35 comprehension errors (20.59%) out of the total errors across the two problems, making this the third most frequent type of error after transformation and encoding errors. One of the most significant examples is a misconception experienced by student S4 in the first problem. The response of student S4 is presented in Figure 3.

1. Dik: Tinggi badan diukur dalam satuan bilangan bulat  
Data hasil pengukuran:

Tinggi badan: 147-151 = 15 siswa  
152-156 = 35 siswa  
157-161 = 28 siswa  
162-166 = 29 siswa  
167-171 = 10 siswa  
172-176 = 8 siswa

Panitia menetapkan tinggi badan minimal mencapai kuartil 3  
Dit: Berapa tinggi badan minimal mencapai yang harus dicapai agar masuk ke seleksi berikutnya? ..

Jawab:  $Q_1 = 172 - 176 = 8$  siswa  
 $Q_2 = 167 - 171 = 10$  siswa  
 $Q_3 = 162 - 166 = 29$  siswa Menggunakan median

$Q_1, Q_2, Q_3 = 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176$   
Jadi minimal tinggi badan adalah 169 cm

Should use the Q3 formula on the group data

Figure 3. Answer to Question 1 S4 Student

Figure 3 shows that student S4 encountered difficulties at the problem comprehension stage. Although the question clearly required students to determine the minimum height corresponding to the third quartile (Q3) for graduation eligibility, the student incorrectly used the median in the calculation. This indicates a misunderstanding of the problem's intent, which subsequently led to errors in the following steps. During the interview, student S4 revealed that they equated the concept of Q3 with the median, assuming that both represent the "middle value" in grouped data and could therefore be used

interchangeably. This conceptual error indicates that the student does not yet have a clear understanding of the distinction between the third quartile (Q3) and the median.

The misconception experienced by S4 is not incidental. Research indicates that errors in understanding problems often stem from students' limited conceptual understanding of statistical concepts, particularly numerical summaries such as mean, median, and mode (Zieffler et al., 2018). Students may develop incorrect conceptions in which all measures of central tendency are perceived as similar or even identical. This issue is often reinforced by instructional practices that emphasize procedures without providing opportunities for students to explore the conceptual meaning of the problems. Latifah & Afriansyah (2021) emphasize that students need learning experiences that connect visual, numerical, and contextual representations of each statistical concept.

Based on this analysis, comprehension errors are among the more dominant types of errors in this study. These errors indicate that students still face difficulties in understanding the information presented in statistical problems. This finding is supported by Aulia et al. (2025), who reported that students tend to focus on computation without understanding the mathematical meaning of the data, leading to misinterpretation, missing data, or incorrect procedures. To address comprehension errors, instruction should be designed using a more holistic approach that emphasizes conceptual understanding, such as incorporating visual representations, facilitating conceptual discussions, and using meaningful contexts in problem presentation. This approach is consistent with the findings of Safira & Masriyah (2024), which show that visual scaffolding can help students better understand the information in problems and reduce the occurrence of comprehension errors.

### Transformation Errors

Transformation errors are the most dominant type of error in this study, with 47 cases (24.12%) identified. Transformation errors occur when students are able to read and understand the problem correctly, but fail to convert the contextual information into an appropriate mathematical representation. An example of a transformation error made by a student is shown in Figure 4.

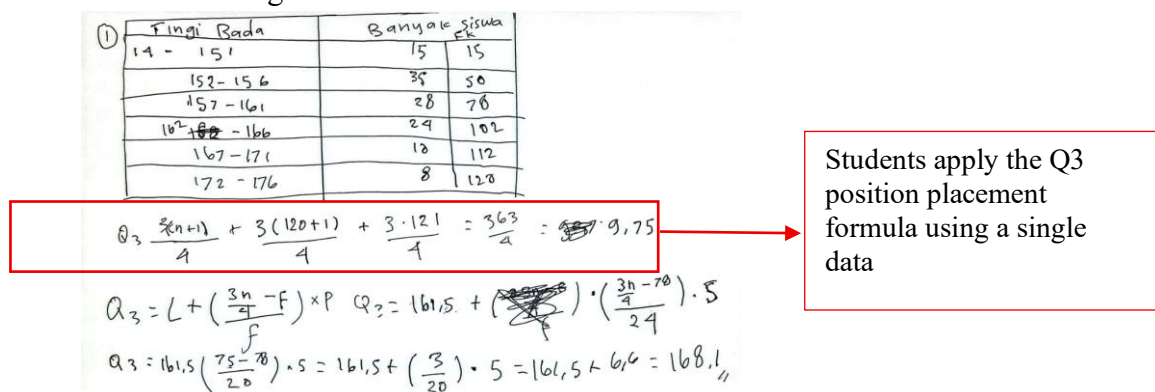


Figure 4. Answer to Question 1 S8 Student

Figure 4 shows the response of student S8 to the first problem. The student correctly understood that the task required determining the third quartile (Q3) from height data presented in a frequency distribution table (grouped data). However, when selecting the appropriate formula, S8 made an error by using the formula for ungrouped data,  $Q_3 = \frac{3(n+1)}{4}$

, instead of the appropriate formula for grouped data,  $Q_3 = \frac{3n}{4}$ . This error indicates that the student was unable to distinguish between different types of data. This inability led to the use of an inappropriate formula, which consequently resulted in an incorrect final answer despite subsequent calculations. The interview results also revealed that S8 admitted having difficulty distinguishing between ungrouped and grouped data, which led to the incorrect choice of formula. This finding suggests that the student relied more on procedural memory rather than a conceptual understanding of the statistical principles underlying the use of the formula.

These findings are consistent with previous studies indicating that transformation errors are among the most dominant types of errors in mathematical problem-solving. Rohilah et al. (2024) reported that 61.42% of students' errors occurred at the transformation stage due to difficulties in translating given information into mathematical form. This is further supported by Nugraha & Basuki (2021), who found that approximately 40% of students failed to convert frequency tables into appropriate mathematical formulas. Such errors often occur because students lack sufficient understanding of the conceptual structure required to solve the problems.

Based on this analysis, the transformation errors identified in this study reveal a gap between students' conceptual understanding and their use of mathematical procedures. Students tend to memorize formulas without understanding the underlying concepts, which leads to difficulties in selecting appropriate methods when faced with varied statistical problems. These findings suggest that statistics instruction should place greater emphasis on conceptual understanding and the ability to select appropriate solution strategies. In addition, the development of mathematical representation skills and data interpretation should be strengthened so that students are able to transform problem information into accurate mathematical models. Kartini et al. (2023) reported that problem-based learning can reduce transformation errors more effectively than traditional instructional methods. Through this approach, students are not only able to perform calculations but also understand the rationale behind the methods used in problem-solving.

### **Process Skill Errors**

Process skills errors occur when students perform mathematical operations or calculations. In this study, there were 41 process skills errors (23.56%) out of the total errors, making this type the fourth most frequent after transformation, encoding, and comprehension errors. Errors at this stage typically occur among students who already have the correct procedures and strategies but fail in the execution of calculations. An example of a student's error in process skills is shown in Figure 5.

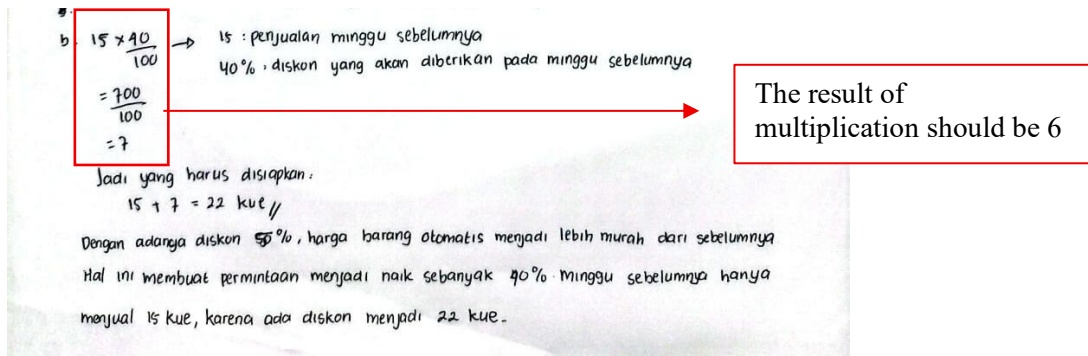


Figure 5. Answer to Question 2 S30 Students

Figure 5 (Student S30’s response to Question 2) shows that the student made an error during the calculation process. In this problem, S30 was required to determine the number of cheesecakes to be prepared by considering discounts and increased sales. One of the key calculations involved multiplying  $15 \times 40$ , which should result in 600. However, the student wrote 700 as the result. This error is not conceptual in nature, as the student understood that multiplication was required, but rather occurred during the execution of the calculation. The interview results also revealed that S30 acknowledged actually knowing the correct multiplication result, but due to rushing and a lack of carefulness, the student wrote an incorrect answer without rechecking it.

These findings are consistent with previous studies indicating that process skills errors frequently occur at the stage of numerical computation. Damayanti & Loviana (2024) found that 27.6% of students’ errors occurred at the process skills stage, with the main causes being a lack of precision and the absence of verification strategies during calculations.

Based on this analysis, it can be concluded that process skills errors in this study were largely caused by students’ lack of carefulness in performing calculations. These errors indicate that students are not yet accustomed to rechecking their results. Therefore, mathematics instruction should encourage students to reflect on each step of their problem-solving process. The ability to verify calculation results is an essential skill that can help students reduce errors, obtain more accurate answers, and improve the overall quality of their problem-solving processes.

### Encoding Errors

Encoding errors refer to mistakes that occur at the final stage of the problem-solving process, when students are unable to communicate the final result correctly, even though the preceding steps have been carried out properly. In this study, encoding errors accounted for 46 cases (27.05%) across the two given problems, a frequency nearly equal to that of transformation errors (47 cases). This indicates that issues in mathematical communication are as significant as difficulties in conceptual transformation. An example of an encoding error is presented in Figure 6.

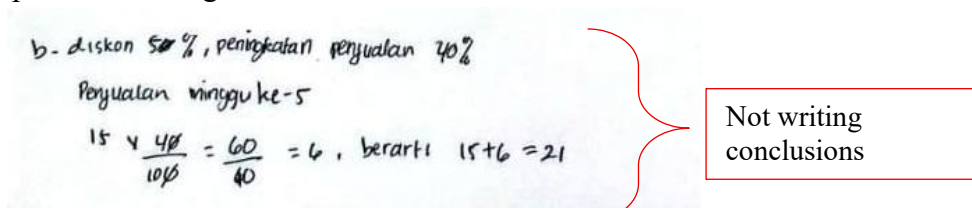


Figure 6. Answer to Question 2 S13 Students

Figure 6 (Student S13's response to Question 2) shows that the student made an encoding error in the second problem. In this case, S13 performed the calculations accurately and demonstrated a correct understanding of the procedure. However, at the final stage, the student only wrote the numerical result without providing a conclusion or interpretation explaining the meaning of the result. The answer consisted solely of a number, without clarifying what the number represented within the context of the problem.

The interview results revealed that the student felt it was sufficient to write only the final numerical answer, assuming that the teacher would understand its meaning. This indicates that the student is not yet accustomed to communicating solutions in a complete mathematical statement. This condition suggests that students' mathematical communication skills still need to be strengthened through instruction.

These findings are consistent with previous studies showing that encoding errors often occur because students are not accustomed to writing conclusions for their answers. Safitri et al. (2022) noted that such errors are frequently caused by students working hastily and focusing primarily on calculations, which leads them to omit conclusions. As a result, the answers provided are often incomplete or not aligned with the context of the problem. This highlights that mathematical communication is an essential skill that needs to be developed in mathematics learning. Tanzimah & Sutrianti (2023) also reported that 67.85% of students made errors in writing final answers due to not presenting conclusions correctly.

Based on this analysis, it can be concluded that encoding errors in this study indicate that students are not yet fully accustomed to communicating the results of their problem-solving processes comprehensively. The answers given are often limited to numerical results without adequate explanation. This suggests that students' mathematical communication skills need to be improved through instructional practices that encourage them to write clear and complete conclusions. In this way, students will not only be able to perform calculations correctly but also communicate their solutions in a systematic and understandable manner.

## **CONCLUSION**

This study aims to analyze errors made by grade XI students in solving statistical problems based on Newman Error Analysis. The results indicate that transformation errors (24.12%) and encoding errors (27.05%) are the most dominant types of errors, followed by process skills errors (23.56%), comprehension errors (20.59%), and reading errors (0.59%). The dominance of transformation errors suggests that students experience difficulties in converting contextual information into appropriate mathematical forms, while the high frequency of encoding errors indicates that students are not yet accustomed to clearly communicating their final answers in accordance with the problem context.

These findings imply that mathematics instruction, particularly in statistics, needs to place greater emphasis on conceptual understanding, problem transformation skills, computational accuracy, and students' mathematical communication. Therefore, teachers are encouraged to implement instructional strategies that promote conceptual understanding, the use of multiple representations, and the habit of writing conclusions in a systematic manner.

This study has several limitations, including a relatively small sample size, the use of instruments consisting of only two questions, and the lack of testing on the effectiveness of the proposed instructional strategies. Therefore, future research is recommended to involve a larger sample and to examine instructional interventions that can more effectively reduce students' errors.

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