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Error Analysis in Solving Mathematical Word Problems Among Prospective Elementary Teachers Using Newman's Theory

Nur'aini Muhassanah [1]*, Novi Andri Nurcahyono [2]
[1]Mathematics Department, Universitas Nahdlatul Ulama Purwokerto, Central Java, Indonesia
[2] Elementary Education Department, Universitas Negeri Jakarta, Jakarta, Indonesia
*Correspondence: nuraini8790muhassanah@gmail.com

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ABSTRACT

Low achievement in mathematics among students outside of mathematics-focused programs is often attributed to frequent errors in solving mathematical problems. This study aims to identify and describe the types of errors made by students in solving mathematical problems using Newman's Error Analysis framework. Employing a qualitative case study approach, the research involved 18 students from the Elementary School Teacher Education Program who were enrolled in mathematics courses during the odd semester of the 2023–2024 academic year. Data were collected through diagnostic tests and follow-up interviews to explore errors related to five key stages identified by Newman's theory: reading, comprehension, transformation, process skills, and writing the final answer. Participants were selected using purposive sampling, and data validity was ensured through triangulation. The analysis involved data reduction, data display, and conclusion drawing. The findings revealed that the most frequent errors were in process skills (32.97%), followed by errors in writing the final answer (29.67%) and transformation errors (27.47%), all of which were categorized as moderately high. Errors in comprehension were the least frequent (9.89%) and categorized as very low. These results underscore the need for targeted instructional strategies to strengthen students' understanding of mathematical concepts and to encourage independent practice, particularly in solving word problems. Future research may explore interventions aimed at reducing specific types of errors based on Newman's framework.

Keywords: Mathematics, Newman Theory, Error, Problem Solving

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Introduction

The study of structures, relationships, patterns, and operations involving numbers, forms, and symbols is the focus of the scientific discipline of mathematics. As a basic science, mathematics has an abstract and deductive nature, where existing concepts are built through definitions, axioms, and logical proofs. (Schoenfeld, 2016). The existence of mathematics is very broad, not only limited to exact fields such as physics and engineering, but also has a significant impact on social and economic sciences as a tool for analysis and decision making (City, 2017). Therefore, a good understanding of mathematics is essential in various disciplines.

Mathematics is also a compulsory course in various study programs, especially those related to science, technology, economics, and education. In academic settings, mathematics is often taught in basic forms such as Basic Mathematics, Calculus, Statistics, and Applied Mathematics. However, students who come from non-mathematics study programs often face great challenges in understanding and mastering the material taught (Dreyfu, 2002) This is particularly critical for prospective elementary school teachers, as their conceptual understanding directly influences how they will teach mathematics to young learners. However, math is often associated with stress and frustration (Amran & Bakar, 2020). Engagement with tasks that require a mathematical approach triggers anxiety in many students. Math anxiety is a form of stress or tension that causes negative emotional responses, physical reactions, and also cognitive reactions to mathematics that inhibit one's ability to learn and perform mathematical activities (Rozgonjuk et al. 2020). If math anxiety is not addressed, it will give students a negative learning experience when learning math such as poor learning achievement (Passolunghi et al., 2016).

Students' difficulties in understanding mathematical concepts have been the concern of many researchers. Several studies have identified various problems that students often face in mathematics courses, such as difficulties in understanding basic concepts (Schoenfeld, 2016), lack of skills in solving problems systematically (Dreyfus, 2002), and mathematical anxiety that hinders students' concentration when working on problems (Ashcraft & Krause, 2007). In addition, errors in applying formulas or calculation procedures are also one of the main obstacles in solving math problems correctly (Dj Pomalato et al., 2020).

Prospective elementary teachers who do not have a strong math background often experience some specific difficulties in this course. The mistake in comprehending the issue is one of the primary challenges, where prospective elementary teachers fail to translate the problem into a mathematical form that can be processed further (Hashemi et.al., 2019). In addition, the lack of understanding of basic concepts makes prospective elementary teachers frequently commit formulas to memory without comprehending their meaning and application of these concepts in problem solving. This is exacerbated by weaknesses in critical and logical thinking that cause prospective elementary teachers to have difficulty in analysis problems systematically (Cahaya & Ansori, 2025). Inaccuracy in the use of problem-solving strategies also often occurs, where prospective elementary teachers choose the wrong solution method or are not in accordance with the characteristics of the problem at hand. This also happens to prospective elementary teachers in the Universitas Terbuka Elementary School Teacher Education study program who have addressing issues in mathematics classes might be challenging.

Students frequently make errors when solving mathematical word problems due to a lack of conceptual understanding, difficulties in interpreting problem statements, and ineffective problem-solving strategies (Maharani et al., 2024). Therefore, a systematic approach is needed in analysis the types of errors that occur so that the right solution can be found. Several theories have been developed to analysis student errors in mathematics. Polya's Error Theory categorizes errors in problem solving into four steps: comprehending the issue, creating a plan, carrying it out, and reviewing the outcomes (Rofi'ah et al., 2019). In addition, there are conceptual and procedural errors in solving problems that often occur at every school level (Wiest & Amankonah, 2019).

Newman's theory was developed by Anne Newman as a method to analysis errors in solving mathematics problems. This theory identifies five stages in problem solving that are potential sources of error, namely reading errors , comprehension, transformation errors, process skill errors , and encoding errors (Jha, 2012). Furthermore, Newman's Theory offers a more systematic approach in identifying student errors in solving mathematics problems. Newman's theory offers a more systematic approach in identifying student errors in solving mathematics problems. This approach allows a more in-depth analysis of the types of errors made, so that the solutions provided are more targeted to improve mathematical understanding. This model is considered more relevant because it is able to specifically identify the types of errors made by students in solving story problems, which often involve reading comprehension and sequential application of mathematical concepts (White, 2005). In addition, the gradual approach in Newman's theory is in line with the purpose of this study, namely to deeply reveal the types of student errors so that more targeted learning solutions can be found (Singh, 2009).

According to earlier studies, pupils most frequently make comprehension and transformation errors. This error causes students to be unable to solve the problem correctly because they fail to understand the essence of the problem given and have difficulty in converting existing information into a mathematical form that can be processed further. Therefore, by using Newman's theory-based analysis, educators can identify where students' errors lie and design more effective learning strategies to overcome these problems.

Various studies have revealed errors that are often created by pupils to solve mathematical problems. The results of the study found that elementary school teacher education study program students committed errors when composing the final response and altering mathematical symbols because they lacked the necessary problem-solving skills (Bulu, 2020). The mistakes resulted from the students' incapacity to comprehend the subject and their insufficient grasp of mathematical ideas. The results of other studies corroborate these findings by showing that processing skill errors and encoding errors are the primary causes of students' failure to solve math story problems (Oktaviana, 2018). Furthermore, according to previous study findings, pupils in the high, medium, and low groups face the same challenges at the transformation, process skill, and encoding stages (Ashari et al., 2023).

Based on the explanation above, it can be inferred that student mistakes in their work on math problems are a problem that needs special attention. Difficulties in understanding concepts, reading problems correctly, and applying problem-solving strategies are the main factors that cause low learning outcomes for students in the Teacher Education Study Program for Elementary School. Therefore, an error analysis approach using Newman's Theory is an effective tool in identifying the source of student errors. Most of the research on math error analysis based on Newman's theory applied to school students. This research focuses on prospective elementary school teachers who should have a strong understanding in basic mathematics. By understanding the types of errors that occur, lecturers and educators can design more effective learning strategies to overcome this problem, so that it can contribute to improving the effectiveness of mathematics learning for students outside the Mathematic study program.

Methods

The purpose of this study is to use Newman's theory to characterize students' errors in solving mathematical problems. The method of this research is qualitative with a case study approach, which is to study the case phenomenon in depth to obtain information (Creswell, 2019). This study involved 18 students in total, 7 of whom were male and 11 of whom were female, and was carried out during the odd semester of the 2023–2024 school year who took Mathematics courses at the Universitas Terbuka Elementary School Teacher Education Study Program as the subject of this research. Purposive sampling was used in this study, meaning that the sample was selected with specific goals in mind (Etikan et.al., 2016).

The selection of subjects in this study was carried out by purposive sampling by considering several specific criteria that were in accordance with the objectives of the study. The criteria used included: (1) students registered in mathematics courses at the Elementary School Teacher Education Study Program (PGSD) in the odd semester of the 2023–2024 academic year, (2) having a non-mathematics background, and (3) willing and available to participate in the entire series of data collection activities, including diagnostic tests and interviews. The selection of participants with these characteristics was considered relevant because they tend to have difficulty in solving mathematics problems, so they are expected to provide more complete and diverse information regarding the types of errors that occur in the process of solving mathematics problems.

In contrast to other research that often concentrate on school children or math students, this study focuses on elementary school teacher education students who will eventually become teachers. In addition, error analysis was conducted based on the five stages of Newman's theory (reading, comprehension, transformation, process skills, and encoding errors), so as to reveal the types of errors in more detail. The study not only analyzes errors using Newman's theory, but also examines how these errors may affect the quality of mathematics teaching at the primary school level.

This research data was collected by giving test and non-test instruments. Test-shaped instruments were made to obtain data related to student learning achievement results which then the test results were analysed to obtain data on errors made by students according to Newman's theory, for a diagnostic test in the form of a description consisting of 4 questions related to derivative applications, one example of the question is: "*An aquarium maker will install an aluminum list on each side of the aquarium he made. The aquarium maker has an aluminum list 80 m long and is installed for 16 aquariums. If the size of the aquarium is* $((9x - 3) \times (4x + 2) \times (5x))$ cm, *what are the actual length, width and height of the aquarium?*". The indicators used in the problem-solving test on Mathematics problems are as follows:

Table 1. *Indicators of Mathematical Problem Solving*

No	Question Indicator	Questions
1	Mathematical issues can be transformed into mathematical models by students so that they can find the length, width, and height of the beam according to what is understood about the issue.	1
2	Students are able to apply the principle of value comparison, model information in the form of mathematical equations, and solve mathematical equations in finding the width of a plane.	2
3	Students can find solutions to difficulties by implementing the concept of geometric rows and series.	3
4	Students can transform problems into mathematical models which are then solved with the concepts of mean and median.	4

Furthermore, for non-test instruments, an unstructured interview method was used. Interviews in this study were conducted offline (face-to-face) after the diagnostic test was carried out in order to gain a deeper understanding of the types and causes of errors made by students in solving mathematics problems. A total of 10 students were selected to be interviewed, each representing two participants from each type of error based on Newman's theory (reading, understanding, transformation, process skills, and writing final answers). The selection of interview informants was carried out purposively based on test results that showed the dominance of certain types of errors in each participant.

Interviews were conducted in a semi-structured manner using an open-ended question guide, designed to explore students' thinking processes when solving problems. Examples of questions asked included: "What do you understand from this problem?"; "Why did you choose this step in solving the problem?"; "What were the main difficulties you faced when working on this problem?"; and "Are you sure about the answer you wrote? Why?". Each interview was recorded with the consent of the participants and then transcribed and coded for data analysis purposes.

To get more in-depth information about student errors, in-depth interviews were conducted. Furthermore, analysing whether a correlation exists between learning desire and the results of errors made by students. The indicators for math errors according to Newman's Theory are described in table 2 below:

Table 2. *Newman Theory Error Classification Guidelines*

No	Stages in Newman Theory Error Analysis	Error Indicator
1	Reading	Although they are able to read, they are unable to comprehend the problem's meaning.
2	Comprehension	1. Students either write incorrectly or lack knowledge of the problem 2. Did not proceed with the process, but wrote down what was understood and asked the exact same question 3. Putting in writing what is understood and inquired about but lacks significance (ambiguity).
3	Transformation	1. Students lack the ability to choose and identify mathematical operations, processes, and formulas. 2. Unable to convert the information in the problem into mathematical form.
4	Process skill	1. Students are unable to perform the math calculation process correctly. 2. Unable to continue the completion procedure 3. Continues the calculation process but is not correct because there is an incorrect algebraic concept. 4. make mistakes in the calculation process.
5	Encoding	1. Write notations (negative signs, symbols, equal signs, etc.) incorrectly. 2. Did not write variables/ and incorrect use of units. 3. Wrong in writing the final answer.

(Jha, 2012)

Errors in answering math problem solving problems made by students can be percented by using formulas such as the following equation (1).

$$P_i = \frac{n_i}{N} \, x \, 100\% \qquad (1)$$

Description:

Pi = percentage of each error category

ni= number of errors for each error category

N = number of errors for all error categories

The proportion of mistakes that students make is classified into 5 categories, namely very high, high, quite high, small, and very small error categories.

***Table 3**. Error Categories*

Percentage (%)	Category
P ≥ 50%	Very High
40 ≤ P < 55	High
25 ≤ P < 40	Moderately High
10 ≤ P < 25	Low
P <10	Very Low

The study employed data reduction, data presentation, and conclusion drafting as data analysis methodologies. This approach is used to ensure transparency of the analysis process as well as methodological rigor in interpreting data obtained from diagnostic tests and interviews. In the data reduction stage, the researcher grouped and filtered the data based on five error categories according to Newman's theory, namely: reading errors, understanding, transformation, process skills, and writing the final answer. Test result data and interview transcript excerpts relevant to each category were selected and coded using manual coding techniques.

Next, at the data presentation stage, the reduced information is arranged in the form of a matrix or error classification table, making it easier to see the dominant error patterns and the relationships between error types. This presentation also includes direct quotes from interview transcripts that represent students' thinking in each error category. The final stage is drawing conclusions and verification, where researchers interpret the meaning of the error patterns found and cross-verify the test data and interview results (triangulation). This process not only produces descriptive findings regarding the proportion of errors, but also qualitative explanations of the reasons behind the occurrence of these errors. By explicitly linking framework with Newman's categories, this analysis provides a strong basis for developing targeted learning recommendations (Miles & Huberman, 1994).

In order to determine the reasons behind student errors, the data validity employed in this study which took the form of method triangulation was accomplished by comparing test results with student interview results.

Results and Discussion

The results indicate that has been conducted by researchers, data obtained in Table 4 shows the types of mistakes students make when attempting to solve story problems in math classes based on the phases of Newman's theory in detail.

***Table 4.** Types of Student Errors Based on Newman Stages*

No	Subject Code	Value	Question			
			1	2	3	4
1	AS	100	B	B	B	B
2	AP	100	B	B	B	B
3	AH	62	B	T, E	T, P, E	C, T, P, E

4	AZ	74	C, T, P, E	T, P, E	B	B
5	AN	100	B	B	B	B
6	AR	67	B	T, P, E	P	C, T, P, E
7	AM	67	C, T, P, E	T, P, E	P, E	B
8	AF	69	B	P, E	T, P, E	T, P, E
9	AE	100	B	B	B	B
10	CR	100	B	B	B	B
11	DR	100	B	B	B	B
12	IP	54	T, P, E	T, P, E	C, T, P, E	P, E
13	IR	72	B	T, P, E	T, P	T, P, E
14	NG	74	T, P, E	B	T, P	T, P, E
15	SM	90	B	B	P, E	B
16	WS	64	T, P, E	C, T, P, E	C, T, P, E	B
17	YS	95	B	B	B	P
18	YP	62	C, T, P, E	B	C, T, P, E	B

Description:

B: Correct Answer X: No Answer R: Reading Error

C: Comprehension Error T: Transformation Error P: Process Skills Error

E: Final Answer Writing Error

Based on the data in Table 4, we can see the error data made by each student, based on the phases of Newman's theory, it is evident that a large number of students continue to make mistakes. Students make mistakes in grasping the problem, transforming it, using process skills, and producing the final response. Additionally, Table 4 demonstrates that six of the 18 students who completed diagnostic test questions using Newman's mistake criteria provided accurate answers 4 of the 4 problems given, 3 students who answered correctly 3 of the 4 problems given, 2 students answered 2 correctly of the 4 problems given, 7 students answered 1 correctly of the 4 problems given and 1 student who could not answer correctly the whole question given. Based on the findings of the collected data. The percentage of student errors in table 5 according to Newman's theory is summarized as follows.

Table 5. *Percentage of Student Errors*

Question Number	Error Type K1	K2	K3	K4	K5
1	0	3	6	6	6
2	0	1	7	7	8
3	0	3	7	10	7
4	0	2	5	7	6
Total	0	9	25	30	27
Percentage (%)	0	9.89	27.47	32.97	29.67

Description:

K1: Reading Error K3: Transformation Error K5: Encoding Error

K2: Comprehension Error K4: Process Skill Error

Based on table 5, it can be seen that the most errors occurred at the process stage with a percentage of 32.97% with fairly high criteria, then followed by errors in writing the final answer with a percentage of 29.67% with fairly high criteria, transformation errors as much as 27.47% with fairly high criteria, errors in understanding as much as reading questions as much as 9.89% with very low criteria. This demonstrates that students made four mistakes in each task out of the five categories of faults according to the Newman stage, except for errors in reading the problem. This shows that students' ability to read the problem is good. Furthermore, the percentage of errors is summarized as follows on each problem in table 6.

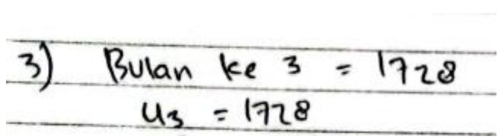
***Table 6**. Error Presentation of Each Problem*

Error Type	Question Number			
	1	2	3	4
Reading Error	0	0	0	0
Comprehension Error	3	1	3	2
Transformation Error	6	7	7	5
Process Skill Error	6	7	10	7
Encoding Error	6	8	7	6
Total	21	23	27	20
Percentage (%)	23.08	25.27	29.67	21.98

Table 6 shows the percentage of mistakes students made for each problem, the results obtained are problem number 3 with the most the percentage of students that make blunders of 29.67% with fairly high criteria, then followed by problem number 2 with 25.27% with fairly high criteria, then 23.08% for problem number 1 and problem number 4 with the least students making mistakes with a percentage of 21.98% with low criteria. From this data, it shows that the results of the mistakes made are not so significant because each question the percentage of errors made by students does not have a significant difference, almost every problem has a stage of error made by students according to Newman's theory.

1. Comprehension Error

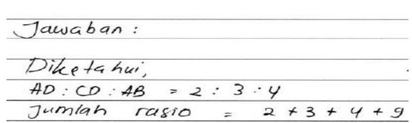
The following is the work of student who fail to grasp the problem correctly illustrated in Figure 1 and Figure 2 below.



3) 3rd month = 1728
$U_3 = 1728$

***Figure 1**. The results of AR subject's work question number 3*

Figure 1 demonstrates that by failing to record what was known and what was asked, the subject made a comprehension error. The subject only wrote the 3rd month = 1728; $U_3 = 1728$.



Answer:
Known to:
AB : CD : AB = 2 : 3 : 4
Number of ratios: 2 + 3 + 4 = 9

***Figure 2.** The results of the work of subject AZ question number 2*

Figure 2 further demonstrates the subject's error. It is evident that the subject misunderstood the problem where it appears that the subject did not write the information completely. The subject only wrote the comparison ratio AD : CD : AB = 2 : 3 : 4 and the sum of the ratios without any additional explanation. Based on Figures 2 and 3, it was found that both subjects made mistakes in understanding the problem. However, the two subjects have different locations of errort is known from the findings of the two subjects' interviews that both AR and AZ subjects have not been able to understand the real problem presented in the problem.

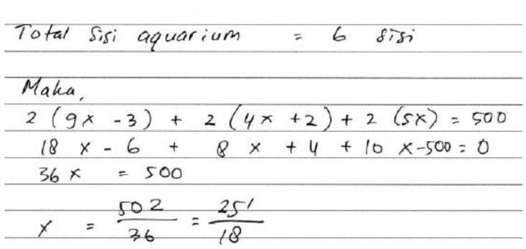
The results of this study were 9 errors in understanding the problem from the test results consisting of 4 items carried out by 7 students. The reason why pupils make mistakes when solving the problem writing what is known and requested by the problem is not accustomed to the comprehension stage, students are not careful in reading the questions, students rush in doing the questions and there are still students who do not understand the meaning of the questions.

The findings of this study indicate that the level of misunderstanding is in the very low category, with a percentage of 9.89%. However, in contrast to Oktaviana's study which found misunderstanding as one of the dominant types of errors (Oktaviana, 2018), this study actually shows that misunderstanding is not the main obstacle for students who are the subjects of the study. This indicates that at the higher education level, especially PGSD students, understanding of the contents of the questions tends to be better compared to the ability in the next problem-solving stages.

Furthermore, these results also complement the findings which states that misunderstanding occurs when students do not write down important information from the questions and respond to questions in an inappropriate manner (Suyitno, 2015). In the context of this study, although some participants still had difficulty in interpreting the questions, most were able to identify important information contained in the story questions, which was reflected in the minimal errors at the comprehension stage. Therefore, this study adds a new dimension that the level of misunderstanding can decrease significantly with increasing education level, but still leaves major challenges at the transformation, process skills, and final answer writing stages.

2. Transformation Error

The following is the work of students who made transformation errors illustrated in Figure 3 and Figure 4 below.



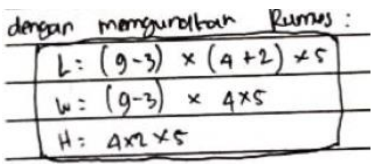
Total aquarium sides = 6 sides
So,

$$2\,(9x-3)+2(4x+2)+2(5x)=500$$
$$18x-6+8x+4+10x-500=0$$

$$36x = 500$$
$$x = \frac{502}{36} = \frac{251}{18}$$

Figure 3. *The results of the work of subject AZ question number 1*

Figure 3 shows student errors at the transformation stage, namely incorrectly determining the total ribs needed to make an aquarium. Where the question request should use formula 4 (p + l + t) to get the value of x so that the length, width and height of the aquarium are obtained but AZ students use the total side of the aquarium is 6 sides.



by sorting the formula:

$$L = (9 - 3)\, x\, (4 + 2) x\, 5$$
$$W = (9 - 3)\, x\, 4\, x\, 5$$
$$H = 4\, x\, 2\, x\, 5$$

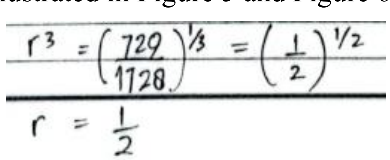
Figure 4. *The results of IP subject's work on question number 1*

In Figure 4, it can be shown that students make transformation errors, where students use formulas to find L (length), W (width) and H (height) not as expected by the question, which should use the equation $L = (9x - 3); W = (4x + 2);$ and $H = 5x$. So it can be concluded that the subjects AZ and IP were wrong in determining mathematical formulas, operations, and procedures to solve the problems in the problem. The error was caused because students did not understand the concepts, formulas or mathematical procedures in the problem. Furthermore, this was confirmed at the interview stage that the subjects AZ and IF wrote incorrect responses because they had trouble figuring out how to solve the problem correctly and didn't understand the subject matter.

Ten students in this study committed twenty-five transformation errors on the four provided items. According to the study's findings, students' ignorance of the formula and algorithm is the root reason of this inaccuracy (Junaedi et al., 2015). Another cause of transformation errors is because students fail to understand the problem. In addition, other errors are caused by students failing to understand the meaning of the problem so that students cannot convert it into mathematical form, students do not understand the steps that must be taken to solve the problem, and students are not careful when working on problems. The level of errors made by students at the problem transformation stage (transformation error) obtained from the calculation of the percentage of error rate of 27.47% with fairly high criteria.

3. Process Skill Error

The results of data analysis related to the work of students who made process skill errors are illustrated in Figure 5 and Figure 6 below.

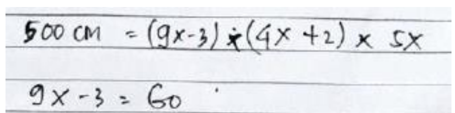


$$r^3 = (\frac{729}{1728})^{\frac{1}{3}} = (\frac{1}{2})^{\frac{1}{2}}$$

$$r = \frac{1}{2}$$

***Figure 5**. The results of AM subject's work question number 3*

From Figure 5 illustrates that the individual made an error in the calculation process, namely the subject miscalculated the results of division and power where $r^3 = \left(\frac{729}{1728}\right)^{\frac{1}{3}} = \left(\frac{1}{2}\right)^{\frac{1}{2}}$ thus obtained $r = \frac{1}{2}$ that is the wrong answer, the correct answer should be $r^3 = \frac{27}{64} \leftrightarrow r = \left(\frac{27}{64}\right)^{\frac{1}{3}} \leftrightarrow r = \frac{3}{4}$.



$$500\ cm = (9x - 3)\ x\ (4x + 2)x\ 5x$$
$$9x - 3 = 60$$

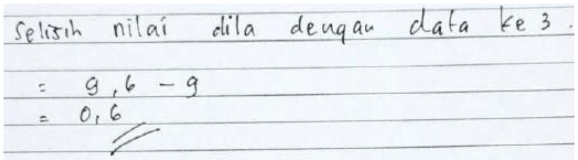
***Figure 6.** The results of AF subject's work question number 1*

Based on Figure 6 shows that subject AF made a mistake in the calculation. It can be seen that the first and second rows are not appropriate because the first row should be processed instead of producing $9x - 3 = 60$ the appropriate answer should be $500 = 180x^3 + 30x^2 - 30x$. This shows that the subject is unable to continue the multiplication operation in the liner equation. According to the interview's findings, the subject's calculation error AM was caused by the subject forgetting the concept of fraction power and division calculation. In addition, another cause is due to the lack of accuracy of the two subjects. In addition, the results of the interview obtained that this error was made because students made mistakes at the previous stage, namely at the problem transformation stage.

Calculation process errors are caused by students failing / unable to use the algorithm in order and correctly (Junaedi et al., 2015). Calculation errors arise when pupils do not follow the process correctly, this finding is consistent who reported that students often make calculation errors when they do not apply the correct steps in problem solving (Abdullah et.al., 2015). In addition, students' mistakes do not continue the computation process due to students' haste with time and there are students who cannot continue the process because they find it difficult and do not know the systematic solution (Agnesti & Amelia, 2020). In this study there were 30 errors from the test results conducted by 10 students on the 4 items given. As for this study, the level of errors committed by pupils at the process skill stage (process skill error) resulting from the calculation of the percentage of error rate of 32.97% with fairly high criteria.

4. Encoding Error

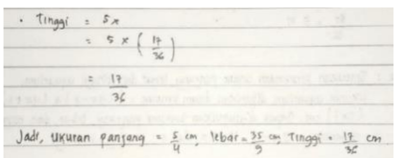
The results of data analysis related to the work of students who made mistakes in writing answers are illustrated in Figure 7 and Figure 8 below.



the difference between the dila value and the 3rd data:
$= 9{,}6 - 9$
$= 0{,}6$

Figure 7. *The results of AF subject's work question number 4*

Figure 7 shows that subject AF has written the final answer. However, the final answer is not the final answer requested. So it can be concluded that the student is wrong in writing the final answer.



High $= 5x$
$= 5\ x\ (\frac{17}{36})$
$= \frac{17}{36}$
so the length size $= \frac{5}{4}cm$, width $= \frac{35}{9}cm$, high $= \frac{17}{36}cm$.

Figure 8. *The results of WS subject's work question number 1*

From Figure 8, it can be observed that the subject can write the final answer. However, the answer is not the final answer requested. So it can be concluded that AF and WS subjects were wrong in writing the final answer. The error was caused by an error in the previous stage, namely the calculation stage. Furthermore, it was confirmed at the interview stage that subjects AF and WS wrote the wrong answer because they had previously used the wrong formula or concept, resulting in a final conclusion that did not match the answer to the question.

This study identified 27 errors committed by 10 students across four mathematical items. The most common errors occurred during the encoding stage, where students struggled to compose accurate final responses. This type of error was committed by the majority of participants. The results of the analysis show that many students still write wrong answers and do not write the final answer. In line with the results of the findings in the study, it is stated that errors in writing conclusions occur when students write conclusions that are not appropriate (Sari & Valentino, 2017). As for this study, the level of errors made by students at the stage of writing the final answer (encoding error) obtained from the calculation of the percentage of error rate of 29.67% with fairly high criteria.

The findings of this study can assist students in identifying the dominant types of errors made frequently make when solving mathematical problems, so enhancing their comprehension and proficiency. The results of this study can also be used as a reference for Elementary School Teacher Education lecturers in designing and implementing more effective learning strategies based on student needs to reduce student errors in understanding and teaching mathematics by modifying instructional materials and teaching procedures to better align with the needs of elementary teacher candidates.

Conclusion

Based on the findings from diagnostic tests and interview data, the most frequent student errors occurred in the process stage (32.97%), followed by encoding errors or composing the final response (29.67%), transformation errors (27.47%), and comprehension errors (9.89%). These results suggest that difficulties related to procedural execution are the most prevalent, while errors in understanding the problem appear least frequently among the participants. Several factors were identified as contributing to these errors: (1) Limited comprehension of the context of word problems; (2) Difficulty in identifying appropriate mathematical operations due to conceptual misunderstandings; (3) Carelessness and forgetfulness during calculations; and (4) Inaccurate steps taken in earlier stages of problem solving, leading to cumulative errors.

In light of these findings, it is recommended that students be encouraged to develop greater independence when working with mathematical word problems. Teachers should emphasize the importance of fully reading and understanding the problem before attempting a solution. In particular, students should be guided to systematically write down all given information and relevant problem details, as this practice enhances comprehension, supports accurate transformation, and promotes the correct execution of procedures. Moreover, instructional strategies that explicitly address each stage of problem solving aligned with Newman's framework may help reduce the frequency of errors and improve overall mathematical problem-solving performance.

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