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Students' Errors in Solving Integer Multiplication and Division Word Problems

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ABSTRACT

This study aims to describe the types of errors and the factors causing such errors made by Grade VII students at SMPN 19 Palu in solving word problems involving multiplication and division of integers. Mathematics education plays a vital role in developing students' reasoning abilities; however, many students still encounter difficulties in operations with integers, particularly in solving contextual problems. Although Newman's Error Analysis has been widely applied, research that thoroughly examines the errors of junior high school students in word problems on integer multiplication and division remains limited, especially in the context of Indonesian students using the Newman's Error Analysis framework. This research employs a qualitative descriptive approach, involving two Grade VII students as research subjects. Data were collected through written tests and interviews, then analyzed using the Miles and Huberman model with reference to the procedures of Newman's Error Analysis: reading errors, comprehension errors, transformation errors, process skill errors, and encoding errors. The findings identified four types of errors: comprehension, transformation, process skill, and encoding errors, while no reading errors were found. Comprehension errors occurred because students failed to identify all relevant information presented in the problems, while transformation errors stemmed from an inability to convert verbal information into mathematical models. Process skill errors resulted from careless calculations, which in turn led to errors in writing the final answers. No reading errors were found among any of the subjects. This study enhances understanding of the characteristics of student errors in the context of word problems on integer operations at the junior high school level. The findings highlight the importance of instruction that emphasizes understanding word problems, constructing mathematical models, and developing the habit of rechecking calculations, so that errors at every stage of problem solving can be minimized.

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INTRODUCTION

Education serves as a fundamental pillar in improving the quality of human resources and constitutes a critical factor in addressing the rapid advancement of science and technology. Through education, students are expected to develop the knowledge, skills, and thinking abilities necessary for everyday life. In Indonesia, formal education is regulated by Law No. 20 of 2003 and is delivered through a tiered system encompassing primary, secondary, and higher education (Heryati et al., 2026; Sahrudin, 2025). Among the subjects that play a significant role in achieving these educational objectives is mathematics. Mathematics instruction aims not only to equip students with computational skills but also to foster logical, critical, systematic, and creative thinking in solving various problems (Pinheiro & Santos, 2025; Ye et al., 2023). Mathematics is a crucial subject for students to learn at school, as it enables them to develop their ability to communicate through a wide range of symbols and to enhance their reasoning skills, which are beneficial for explaining and solving various everyday problems (Kusmaryono et al., 2024). Consequently, mathematics is taught continuously from elementary school through university, as it serves as a foundation for mastering other academic disciplines (Semenov et al., 2023). Nevertheless, mathematics instruction continues to face various challenges, particularly concerning students' ability to solve word problems. Word problems require students not only to master mathematical concepts but also to comprehend the information provided, translate it into mathematical models, perform accurate calculations, and present answers that align with the problem context. Errors at any of these stages can lead to incorrect final answers.

Initial observations at SMPN 19 Palu indicated that seventh-grade students still encounter difficulties in solving word problems involving multiplication and division of integers. According to the mathematics teacher, student errors encompass not only miscalculations but also misinterpretation of the problem, incorrect selection of operations, and flawed final conclusions. This suggests that student errors are attributable not solely to weak computational skills but also to underlying cognitive processes during problem-solving. Therefore, a systematic analytical approach is needed to identify the specific stages at which students make errors. Several error analysis methods can be employed in research, including the Newman Error Analysis (NEA) procedure (Ekasari & Putra, 2024). This framework classifies errors into five categories: reading errors, comprehension errors, transformation errors, process skill errors, and encoding errors (Bulan, 2025). Hoth et al. (2022) identifying errors at each stage, teachers can gain a detailed understanding of where students face difficulties and subsequently determine appropriate instructional strategies to address them.

Previous studies have demonstrated the effectiveness of Newman Error Analysis in identifying student errors in mathematical word problems. These studies have revealed that the most common errors include comprehension errors, transformation errors, and process skill errors. Contributing factors include carelessness in reading the problem, inability to identify known and unknown information, difficulty in translating problems into mathematical models, and weaknesses in performing arithmetic operations (Nurjanah & Angraini, 2024). These findings indicate that student errors are influenced not only by computational proficiency but also by the ability to understand and process the information presented in the problem.

However, existing research has several limitations. Most studies have focused solely on describing error types based on Newman's stages without examining in greater depth the relationship between error types and the specific characteristics of the mathematical content being studied. Furthermore, previous research has generally been conducted on other mathematical topics, such as systems of linear equations, fractions, sets, and algebra; thus, their findings may not fully capture the characteristics of student errors in integer multiplication and division. Research specifically examining this topic at the junior secondary level, particularly in the context of SMPN 19 Palu, remains scarce. This is a notable gap, as multiplication and division of integers are prerequisite skills that play a crucial role in understanding subsequent mathematical content, including algebra, linear equations, and algebraic operations (Marqozi et al., 2023). Accordingly, the characteristics of student errors on this topic warrant further investigation.

The novelty of this study lies not merely in applying Newman's Error Analysis to word problems involving integer multiplication and division, but also in examining how errors at different stages are interconnected within students' problem-solving processes. By integrating students' written responses with interview data, the study reveals how incomplete comprehension may lead to inappropriate mathematical transformations, which subsequently affect procedural execution and the accuracy of final answers. This sequential interpretation provides a more analytical account of students' errors than studies that classify error types independently without tracing their possible relationships.

Based on the above discussion, a research gap emerges: there have been relatively few studies that specifically analyze student errors in solving problems involving multiplication and division of integers using Newman's Error Analysis, while also linking the types of errors to their underlying causes within the learning context at SMPN 19 Palu. Such understanding is essential as a basis for designing more effective instructional strategies to reduce student errors.

This study therefore focuses specifically on analyzing errors related to multiplication and division of integers among Grade VII students at SMPN 19 Palu using Newman's Error Analysis. It integrates the identification of error types with an exploration of their causes through analysis of student work and interviews. Unlike previous research, which generally only describes errors across a range of mathematical topics, this study provides a more comprehensive overview of the relationship between the types of errors encountered and their underlying causes in the context of integers. The findings are expected to serve as a reference for teachers in developing targeted instructional strategies to minimize student errors in this fundamental area of mathematics.

Against this background, the research questions of this study are: (1) What types of errors do Grade VII students at SMPN 19 Palu make when solving word problems involving multiplication and division of integers, based on Newman's Error Analysis? and (2) What factors cause these errors? In line with these questions, the objective of this research is to describe the types of errors and their underlying causes among Grade VII students at SMPN 19 Palu when solving word problems on multiplication and division of integers, using Newman's Error Analysis.

METHOD

This study employed a qualitative approach with a descriptive research design. The qualitative approach was selected because it aims to obtain an in-depth understanding of the types of errors made by students and the contributing factors in solving word problems on multiplication and division of integers. The data produced consist of descriptive accounts derived from students' written work, interview results, and the researcher's interpretation of students' thought processes during problem-solving. The research was conducted at SMP Negeri 19 Palu, located on Jalan Untad I Bumi Roviga, Kelurahan Tondo, Kecamatan Mantikulore, Kota Palu, Provinsi Sulawesi Tengah, in the even semester of the 2025/2026 academic year. The research location was selected based on initial observations indicating that seventh-grade students still experience difficulties in solving word problems on multiplication and division of integers.

The research subjects were seventh-grade students of SMP Negeri 19 Palu. The determination of the research class was conducted purposively based on the recommendation of the mathematics teacher, namely the class with the lowest learning achievement compared to other seventh-grade classes. Subsequently, all students in that class were given a written test, and then two informants were selected purposively. The selection of two informants was based on the objective of qualitative research, which prioritizes depth of information over the number of participants. The two informants were selected because they were able to represent the most dominant error patterns found in the test results, demonstrated error types corresponding to the stages of Newman Error Analysis, were able to communicate their thought processes clearly during the interviews, received recommendations from the mathematics teacher, and were willing to participate as research informants. Thus, the two informants were considered adequate to provide in-depth information in accordance with the research focus.

Data collection techniques included written tests and semi-structured interviews. The test consisted of essay-type questions designed to identify student errors based on the five stages of

Newman Error Analysis, namely reading, comprehension, transformation, process skills, and encoding. The test results were used to identify the types of errors made by students and to determine prospective research informants. Subsequently, semi-structured interviews were conducted after students completed the test to clarify students' thought processes, confirm the types of errors identified in the written answers, and explore the factors contributing to errors at each stage of the Newman Error Analysis.

Data validity was ensured through the application of trustworthiness criteria. Credibility was maintained through technique triangulation by comparing the results of written tests and interviews, as well as member checking, which involved reconfirming the researcher's interpretations with the informants to ensure they aligned with the informants' intended experiences. Dependability was achieved by systematically documenting the entire research procedure, from instrument development, data collection, to data analysis, so that the research process could be traced. Confirmability was maintained by basing all interpretations on empirical evidence in the form of student answer sheets, interview transcripts, and field notes. Transferability was pursued through the presentation of detailed descriptions regarding subject characteristics, research location, research procedures, and research context, enabling readers to assess the potential applicability of the research findings to other similar contexts.

Data analysis employed the Miles and Huberman model, which includes data condensation, data display, and conclusion drawing and verification. The analysis began with identifying each student's answers based on the five error categories in Newman Error Analysis (NEA), namely reading errors, comprehension errors, transformation errors, process skills errors, and encoding errors. Categorization was conducted by matching each student's responses against the indicators for each Newman stage established prior to the analysis process. Subsequently, the categorization results were compared with the interview data to ensure that the identified error types corresponded to the students' thought processes and explanations. In cases where discrepancies were found between written answers and interview results, the researcher re-examined both data sources until a consistent classification was obtained. To enhance confirmability and reduce potential subjectivity, the error categorization results were discussed and reviewed with the thesis supervisor who has expertise in the field of mathematics education. The feedback obtained was used to ensure that each error category was consistent with the indicators at each Newman stage and supported by the available empirical data. Afterward, the condensed data were presented in narrative and tabular forms, followed by conclusion drawing and verification.

RESULTS AND DISCUSSION

SMPN 19 Palu consists of several seventh-grade classes, one of which is class VII B, comprising 23 students. All students were given a test on June 4, 2026, consisting of two questions on the topics of multiplication and division of integers. The selection of research subjects was based on: 1) students who made more errors to represent the mistakes experienced by other students, 2) the errors identified already represented the mistakes of other students, 3) students' ability to communicate and express opinions and thought processes well, and 4) recommendations from the mathematics teacher at SMPN 19 Palu.

The test results on the topics of multiplication and division of integers were all analyzed and described based on Newman’s error analysis. The following is a descriptive summary in the form of grouping students’ errors, namely:

1. Errors in students' work on the answer to question number 1

Based on the students' answers to question number 1, the errors in their work were identified as follows:

Table 1. Students' Errors on Question Number 1

No.	Types of Errors Made by Students	Student Number	Type of Error
1.	Error in reading key words in the question; the student misread important information.	-	Reading Error
2.	The student does not understand the relevant information or is unable to connect that information.	-	Comprehension Error
3.	The student is unable to identify the appropriate concept, strategy, and procedure to solve the word problem.	9, 17	Transformation s Error
4.	The student is unable to perform the correct mathematical calculations.	1,7,9,14,17	process skills Error
5.	The answer is incomplete.	1,7,9,14,17	Encoding Error

Based on the classification of errors made by students in solving problem number 1, student number 9 was selected as a research subject because they represented the most dominant error pattern found in the test results, demonstrated error types corresponding to the stages of Newman Error Analysis, were able to communicate their thought processes clearly during the interview, received a recommendation from the mathematics teacher, and were willing to serve as an informant. Student number 9 is referred to as MR.

2. Errors in students' work on the answer to question number 2

Based on the students' answers to question number 1, the errors in their work were identified as follows:

Table 2. Students' Errors on Question Number 2

No.	Types of Errors Made by Students	Student Number	Type of Error
1.	Error in reading key words in the question; the student misread important information.	-	Reading Error
2.	The student does not understand the relevant information or is unable to connect that information.	1,2,4,6,11,17	Comprehension Error
3.	The student is unable to identify the appropriate concept, strategy, and procedure to solve the word problem.	1,2,4,6,11,17	Transformation s Error
4.	The student is unable to perform the correct mathematical calculations.	1,2,4,6,11,13,14,16,17	process skills Error
5.	The answer is incomplete.	1,2,4,6,11,13,14,17	Encoding Error

Based on the classification of errors made by students in solving problem number 2, student number 17 was selected as a research subject because they represented the most dominant error pattern found in the test results, demonstrated error types corresponding to the stages of Newman Error Analysis, were able to communicate their thought processes clearly during the interview, received a recommendation from the mathematics teacher, and were willing to serve as an informant. Student number 17 is referred to as MY.

Based on the results of students' answers to the administered test, the errors made by students in solving word problems on multiplication and division of integers were most frequently committed by students number 9 and 17. These students were selected as research subjects because they frequently made errors, the errors they committed represented the most dominant error patterns found in the test results, demonstrated error types corresponding to the stages of Newman Error Analysis, were able to communicate their thought processes clearly during the interview, received recommendations from the mathematics teacher, and were willing to serve as informants.

A. Data Presentation of Subject MR on Question Number 1

Question number 1: Mr. Dadang is filling 35 liters of gasoline at a gas station. Suddenly, he remembers that he only has Rp 370,000.00 in his wallet. In a panic, Mr. Dadang has difficulty estimating the amount of money he needs to pay. If the price of 1 liter of gasoline is Rp 10,000.00, does Mr. Dadang have enough money to pay for 35 liters of gasoline?
Based on the Newman stages, the following are the errors made by MR in completing the test:

a. Reading the Question

The following is an excerpt from an interview with MR regarding question number 1.

PN005	:	Let's start with question number 1. Can you read the question again?
MR006	:	Yes, Mr. Dadang is filling 35 liters of gasoline at a gas station. Suddenly, he remembers that he only has Rp 370,000.00 in his wallet. In a panic, Mr. Dadang has difficulty estimating the amount of money he needs to pay. If the price of 1 liter of gasoline is Rp 10,000.00, does Mr. Dadang have enough money to pay for 35 liters of gasoline

From the interview with subject MR, it was found that no reading errors occurred when MR read the question. He was able to read the question well without any difficulty in pronouncing the numbers or figures in the question.

b. Understanding the Question

Figure 1 displays Subject MR's answer to question number 1

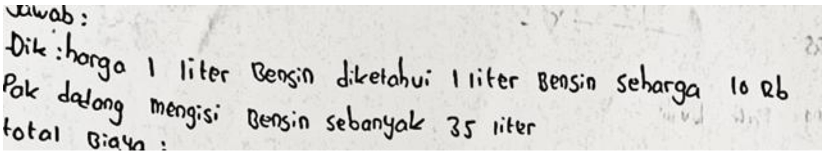

Figure 1. MR's answer to question number 1

The following is an excerpt from an interview with MR:

PN007	:	Could you explain what the question asks you to do?
MR008	:	To find out if Mr. Dadang has enough money to pay for 35 liters of gasoline.
PN009	:	What do you think is the most important information in the question?
MR010	:	In my opinion, Mr. Dadang is filling up 35 liters of gasoline at a gas station. He has 370,000 rupiah in his wallet, and the price of 1 liter of gasoline is 10,000 rupiah
PN011	:	Why didn't you write 370,000 in your known answer?
MR012	:	Oh my gosh, I didn't really pay attention because I just wrote it down yesterday.

Based on MR's written responses and interview data, it was found that MR identified the known information by stating that the price of one liter of gasoline was Rp 10,000 and that Mr. Dadang purchased 35 liters of gasoline. From the information recorded, MR correctly recognized both the price per liter and the quantity of gasoline purchased; however, MR failed to include the amount of money available in Mr. Dadang's wallet. The interview findings indicated that MR had not fully understood the importance of identifying and recording all the given and required information before attempting to solve the problem. Although MR was able to read the problem accurately and recognize its essential information, the participant did not realize that all relevant information needed to be documented comprehensively to support the problem-solving process. This finding is illustrated in excerpts (MR010) and (MR012).

c. Transformation

Figure 2 displays Subject MR's answer to question number 1

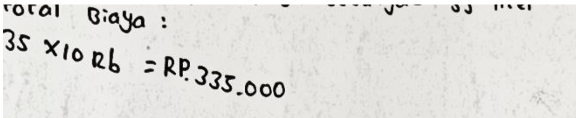

Figure 2. MR's answer to question number 1

The following is an excerpt from an interview with MR:

PN015	:	hat difficulties did you encounter?
MR016	:	After determining the cost of the gasoline, I was confused about what I should do next.
PN017	:	I see. Before we discuss that further, could you explain how you solved the problem?
MR018	:	Certainly. First, I identified the given information: the price of one liter of gasoline was Rp10,000, and Mr. Dadang purchased 35 liters of gasoline. Then, I multiplied 35 x 10,000 = Rp335,000. Based on this result, I concluded that Mr. Dadang had more than enough money to pay for the gasoline, which cost Rp 335,000.
PN019	:	Why did you write "10rb" instead of representing it as the numerical value 10,000 in your solution?
MR020	:	That was my mistake. I thought they meant the same thing, so I did not think it was necessary to write it in mathematical notation

Based on Figure 2, MR demonstrated a transformation error by incorrectly converting the information presented in the word problem into a mathematical representation. Specifically, MR used the notation "10 rb" rather than expressing it formally as 10,000. The interview data further revealed that MR was unable to determine the appropriate mathematical operation required to answer the question of whether Mr. Dadang had sufficient money to purchase 35 liters of gasoline. During the interview, MR explained that they were unsure of the next step after identifying the given information, as illustrated in excerpt (MR016). Furthermore, MR failed to transform the verbal expression "10 rb" into its correct mathematical notation, 10,000 (MR020). This finding indicates that MR experienced difficulty in accurately translating verbal information into a formal mathematical representation. The expression "10 rb" reflects everyday language rather than the formal mathematical notation expected in mathematical problem-solving. In addition, an error occurred during the numerical transformation process, resulting in an incorrect calculation, as shown in excerpt (MR018).

d. Process Skills

The following is an excerpt from an interview with MR:

PN021	:	Why are you using multiplication here? (while pointing at the answer sheet)
MR022	:	Because, in the problem, Mr. Dadang fills up with 35 liters of gasoline. Since 1 liter costs Rp10,000, to find the total price, I multiplied 35 x 10,000 and got 335,000.
PN023	:	Are you sure that the result is 335,000?

MR024	:	Hmm actually, I'm not sure
PN025	:	Why?
MR026	:	Actually, I recalculated it yesterday, but I was confused about my answer. The second time I calculated it, I got 350,000, but I wasn't sure whether that was correct or not. So I didn't continue, I just wrote the conclusion directly based on my initial answer

Based on MR's written responses and interview data, it was also found that MR made a process skills error by obtaining an incorrect intermediate result while solving the problem. Although MR correctly identified the required mathematical operation and understood that multiplication should be applied, an error occurred when calculating (35 x 10,000). MR obtained 335,000 instead of the correct result, 350,000, as evidenced in excerpt (MR022). Moreover, after calculating the cost of the gasoline, MR was uncertain about the subsequent steps needed to complete the solution. Consequently, MR did not perform the remaining calculations required to answer the problem but instead proceeded directly to the final conclusion, as illustrated in excerpt (MR026).

e. Encoding

Figure 3 displays Subject MR's answer to question number 1

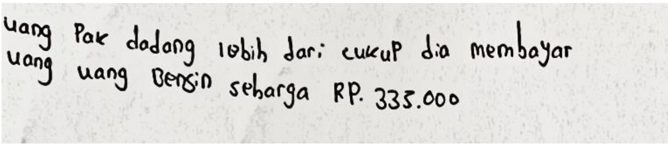

Figure 3. MR's answer to question number 1

The following is an excerpt from an interview with MR:

PN027	:	Okay, could you read your conclusion for me?
MR028	:	Yes, Mr. Dadang's money is more than enough. He pays Rp335,000 for the gasoline
PN029	:	In your opinion, is that conclusion correct?
MR030	:	Hmm, in my opinion, it's not correct yet
PN031	:	Why?
MR032	:	Because I just made up that conclusion randomly

Based on MR's written responses and interview findings, as presented in Figure 3, MR also demonstrated an encoding error by providing an inaccurate final answer. Although MR attempted to draw a conclusion, the final response was incomplete and incorrect. Specifically, MR merely stated that Mr. Dadang had more than enough money to pay for the gasoline without determining the amount of change that Mr. Dadang would receive. Furthermore, the final answer was based on the incorrect gasoline cost of Rp335,000, rather than the correct amount of Rp350,000, as shown in excerpt (MR030). These findings suggest that the errors made during the transformation and process skills stages subsequently affected the accuracy of MR's final answer.

B. Data Presentation of Subject MY on Question Number 2

Question number 2 is as follows: "Mr. Budi saves money regularly for 6 months (1 month = 30 days). Each day, the amount of money saved by Mr. Budi is always the same. The money saved is then used to purchase a television priced at Rp900,000. Determine the amount of money Mr. Budi saves each day." Based on the Newman procedure, the following are the errors made by the subject MY in solving question number 2:

a. Reading the Question

The following is an excerpt from an interview with MY:

PN005 : Can you read question number 2 aloud?

MY006 : Sure, Mr. Budi saves money regularly for 6 months (1 month = 30 days). Each day, the amount of money saved by Mr. Budi is always the same. The money saved is then used to buy a television priced at Rp 900,000. Determine the amount of money Mr. Budi saves each day.

From the answers and the interview with subject MY, it was found that there were no reading errors when MY read the question. He was able to read the question well without difficulty in pronouncing the numbers in the problem.

b. Understanding the Question

Figure 4 displays Subject MY answer to question number 2

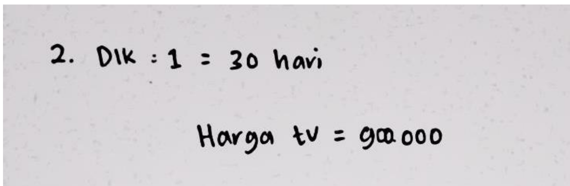

Figure 4. MY’s answer to question number 2

The following is an excerpt from an interview with MY:

PN007 : Can you explain what the question is asking you to solve?

MY008 : To find out how much money Mr. Budi saves each day.

PN009 : In your opinion, what is the most important information in the question?

MY010 : The TV price is Rp 900,000, Mr. Budi saves for 6 months, and 1 month equals 30 days.

PN011 : Why in your answer here (pointing to the answer sheet) did you not write 6 months as given?

MY012 : I didn’t pay attention to that, I only focused on 1 month = 30 days

In Figure 4, MY was able to identify and write down the known information from the question, but not all the information was recorded in the answer sheet. The interview excerpt above shows that MY knew what information was given in the question but was not careful or did not pay attention to including the 6 months in the answer sheet, as seen in (MY012). This error indicates that MY was unable to fully comprehend all the important information in the question. MY only took some of the data and ignored very important information needed to solve the problem.

c. Transformation

Figure 5 displays Subject MY answer to question number 2

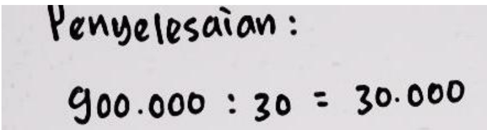

Figure 5. MY’s answer to question number 2

The following is an excerpt from an interview with MY:

PN013	:	Alright, let's continue. Did you experience any difficulties while solving the problem?
MY014	:	No.
PN015	:	Okay, can you show me how you solved the problem?
MY016	:	Sure. First, I knew 1 month = 30 days and the TV price is Rp 900,000. Then I divided 900,000 x 30 days which resulted in 30,000.
PN017	:	Why didn't you include the 6 months in your calculation?
MY018	:	Because I didn't pay attention to the 6 months, I only included what I wrote as known.
PN019	:	Why here (pointing to the answer sheet) did you use division between 900,000 and 30 days?
MY020	:	Because I thought to find out how much Mr. Budi saves each day, I divided 900,000 by 30 days.
PN021	:	Do you think dividing 900,000 by 30 days is correct?
MY022	:	Hmm, not yet, because I didn't pay attention to the 6 months
PN023	:	So, what should you have done?
MY024	:	I should have first calculated the total number of days in 6 months.

From the answers and the interview, it was found that MY was careless in determining the information in the question, specifically the 6 months, which led to errors in determining the steps to solve the problem. MY directly divided the TV price by 30 days without first calculating the total days over 6 months. This indicates that MY was unable to determine an appropriate strategy to solve the problem. This can be seen in (MY016)(MY018)(MY024).

d. Process Skills

The following is an excerpt from an interview with MY:

PN025	:	What operation do you think is used to find the total days in 6 months?
MY026	:	Hmm, I think multiplication.
PN027	:	Why use multiplication?
MY028	:	Because 1 month equals 30 days, so to find the total days in 6 months, multiply 30 x 6
PN029	:	So, is the calculation 900,000 ÷ 30 days = 30,000 correct or incorrect?
MY030	:	It is incorrect

From the answers and interview with MY, it was found that he made errors in the problem-solving process by choosing incorrect steps due to a lack of attention to important information in the question. MY directly divided 900,000 by 30 days without first calculating the total days in 6 months, i.e., 6 x 30 = 180. This caused the final result of 30,000 to be incorrect due to inappropriate steps. This can be seen in (MY030).

e. Encoding

Figure 6 displays Subject MY answer to question number 2

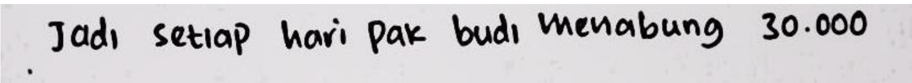

Figure 6. MY's answer to question number 2

The following is an excerpt from an interview with MY:

PN031	:	Can you read the conclusion you wrote?
MY032	:	Sure, so Mr. Budi saves Rp 30,000 every day.
PN033	:	Is this result correct?
MY034	:	No.
PN035	:	Why?
MY036	:	Because I didn't calculate the 6 months first, I directly divided 900,000 x 30, so the result was wrong.

From the answers and interview above, it is known that MY made an error in writing the final answer, stating that Mr. Budi's daily savings were 30,000, which is incorrect because the process or steps to solve the problem were wrong or inappropriate.

Discussion

The research findings indicate that student errors in solving word problems on multiplication and division of integers are not only related to computational ability but also reflect limitations in conceptual understanding, procedural knowledge, mathematical reasoning, and cognitive processing. Based on Newman's stages, the errors made by students are hierarchical in nature, where errors at one stage affect success at the subsequent stage. Thus, solving word problems requires not only computational skills but also the ability to understand the problem context, select solution strategies, and re-evaluate the results obtained (Nasrun et al., 2023). The types of errors according to Newman's theory include: students' errors in reading the problem presented in the question (reading error), errors in understanding the problem (comprehension error), errors in the process skills of problem-solving (process skills error), and errors in writing the final answer (encoding error).

1. Reading Errors

At the reading stage, neither of the two subjects made reading errors. This finding indicates that the primary obstacle does not lie in the ability to recognize symbols, words, or numbers in the problem, but rather in the cognitive processes that occur after the information has been successfully read. In other words, good reading ability does not guarantee success in solving word problems unless it is accompanied by the ability to understand and process information. These results show that students' difficulties occur more at the level of higher-order thinking processes than at the level of mechanical reading ability.

2. Comprehension Errors

At the comprehension stage, neither of the two subjects was able to completely identify the known information and what was being asked in the problem. This condition indicates a weakness in conceptual understanding, particularly the ability to comprehend the relationships among the information presented in the problem. From the perspective of information processing, students tend to focus their attention only on information they consider important for performing calculations, while other information that is actually needed is not processed thoroughly. As a result, the mental representation constructed of the problem becomes incomplete, leading to the selection of less appropriate solution strategies. This finding suggests that comprehension errors are not solely caused by a lack of carefulness, but also because students have not yet been able to construct a complete mental representation before entering the problem-solving stage.

Hokor et al. (2022) indicates that students who provide incorrect answers experience misconceptions due to failure in obtaining and processing relevant information, resulting in the selection of inappropriate solution strategies. Meanwhile, Ghefira and Jupri (2025) found that comprehension errors are influenced by low ability to understand language and a tendency to ignore important information in the problem, which ultimately hinders the problem-solving process. According to Rerek et al. (2025), low conceptual understanding also causes students to experience difficulties in understanding the information provided and translating word problems into mathematical sentences. Compared to the findings of these studies, the results of this research indicate that comprehension errors are not only related to reading ability or language comprehension, but also to students' failure to integrate all available information into a complete mental representation. Thus, understanding word problems is a cognitive process that involves information processing, conceptual understanding, and connecting elements within the problem before students determine their solution strategies.

3. Transformation Errors

At the transformation stage, students experienced difficulties in converting verbal information into an appropriate mathematical model. Errors such as the use of inappropriate operations or incorrect unit conversions indicate that conceptual understanding has not been effectively connected with procedural knowledge. Although students were already familiar with multiplication and division operations, they still experienced difficulties in determining when and how these operations should be applied to solve word problems. From the perspective of mathematical reasoning, students were not yet able to connect the known information with the solution objectives, resulting in mathematical models that did not accurately represent the situation in the problem. This finding suggests that the transformation process does not depend solely on the ability to recall formulas or procedures, but also on the ability to interpret the mathematical meaning of the problem context and select the most appropriate representation. According to (Marcel et al., 2025) transformation errors are also found when students fail to translate information in the problem into the appropriate mathematical form, particularly in algebra material. Meanwhile, Ario et al. (2025) explains that transformation errors can take the form of inappropriate mathematical models, incomplete models, or the omission of necessary steps to construct the model. Compared to the findings of these studies, the transformation errors in this research were more influenced by students' inability to connect the problem context with the concepts of integer operations. This indicates that although the subject matter examined differs, difficulties in constructing mathematical representations from contextual information remain a consistent obstacle in the mathematical problem-solving process.

4. Process Skill Errors

At the process skills stage, errors made by both subjects indicate that procedural knowledge has not been applied consistently. Calculation errors made by MR show a lack of thoroughness and an absence of monitoring of the problem-solving steps that had been taken. Meanwhile, MY skipped an important procedure, resulting in an incomplete solution process. This finding indicates that students not only experience weaknesses in executing solution algorithms, but also have not been able to monitor and evaluate each step they take during the problem-solving process. In fact, metacognitive monitoring plays an important role in detecting errors, correcting inappropriate procedures, and ensuring that each solution step remains consistent with the information available in the problem. According to Zhang and Fiorella (2023), process skills errors occur when students make mistakes in determining or carrying out the appropriate solution steps, while encoding errors are often caused by failure to review their work. The findings of this study also show that process skills errors are the most dominant type of error. This result is in line with the findings of Taamneh et al. (2024), which reported that most students make errors at the calculation stage and in the application of solution procedures. The similarity of these findings indicates that process skills errors are influenced not only by mastery of arithmetic operations, but also by students' ability to control their thinking processes during problem solving. Thus, mathematics instruction needs to emphasize not only procedural accuracy, but also the development of metacognitive strategies that encourage students to actively examine, reflect on, and evaluate their solution steps.

5. Encoding Errors

At the encoding stage, both subjects were able to write the final answer, but the conclusions they produced were incorrect because they were based on erroneous results from the previous stages. This finding indicates that encoding errors do not occur in isolation, but rather are a logical consequence of errors in comprehension, transformation, and process skills. Thus, an incorrect final answer does not necessarily indicate an inability to draw conclusions, but rather reflects an accumulation of errors at the earlier stages. This reinforces the view that Newman's stages are interrelated, where success at the final stage is highly dependent on success at the preceding stages. This finding is in line with the research results of (Ramadhan & Santoso, 2025) in trigonometry, which showed that students tend to make errors in drawing valid conclusions. In addition, the causes of encoding errors include errors in understanding the problem, incorrect calculations, determining an incorrect final result, rushing to write the answer, and forgetting to write the final answer. Meanwhile, (Jukiewicz, 2024) stated that encoding errors occur when research subjects are unable to make a final conclusion, present the final answer, or write an answer based on that conclusion.

Overall, the research results indicate that students' errors in solving word problems are largely influenced by weaknesses in building conceptual understanding, connecting contextual information with mathematical models, systematically applying procedures, and monitoring their own thinking processes. When errors are clearly explained to students, they can identify their misunderstandings, enabling teachers to determine appropriate strategies to address these misconceptions (Schulman & Demantowksy, 2022). Therefore, mathematics instruction should not focus solely on procedural practice or calculations but also provide opportunities for students to develop problem comprehension skills, articulate the reasoning behind their chosen solution strategies, and reflect on the answers obtained. Thus, the learning process is expected to enhance students' mathematical thinking abilities more comprehensively while reducing errors at each stage of Newman’s framework.

CONCLUSIONS

This study concludes that Grade VII students at SMPN 19 Palu experienced four types of errors when solving word problems involving multiplication and division of integers based on Newman’s Error Analysis: comprehension errors, transformation errors, process skill errors, and encoding errors, while no reading errors were identified. Comprehension errors occurred because students failed to identify all relevant information in the problems, transformation errors resulted from difficulties in converting verbal information into appropriate mathematical models, process skill errors were caused by inaccurate calculations and inappropriate procedures, and encoding errors emerged as a consequence of mistakes made in the preceding stages. These findings achieved the research objectives by describing both the types of errors and their underlying causes. The study also contributes to the theoretical application of Newman’s Error Analysis by demonstrating that students’ errors in solving integer word problems are hierarchical and interconnected, where errors at earlier stages tend to propagate to subsequent stages. This finding reinforces the usefulness of Newman’s framework for explaining students’ cognitive processes in mathematical problem solving, particularly in the context of integer operations at the junior secondary level.

From a practical perspective, the findings suggest that mathematics instruction should place greater emphasis on helping students understand problem contexts, identify relevant information, construct appropriate mathematical models, and develop the habit of monitoring and reviewing their solution processes. Such instructional practices may reduce errors at each stage of problem solving and support the development of students' mathematical reasoning and problem-solving abilities. Future research is recommended to involve a larger number of participants from different schools and educational levels to enhance the generalizability of the findings. Further studies may also investigate the effectiveness of instructional interventions designed to reduce specific Newman error types or explore the relationship between students' mathematical errors and other factors, such as metacognitive skills, mathematical literacy, or cognitive styles.

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