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# Analysis of Student's Error in Solving Multiplication Operations in Terms of Mathematical Concept Understanding

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## ABSTRACT

This research was conducted to analyze students' errors in solving multiplication operations in terms of understanding students' mathematical concepts. The subjects of this study were 57 students from two elementary schools in Kupang Regency, East Nusa Tenggara, Indonesia who had previously studied multiplication concepts and operations. This research method is descriptive quantitative with error analysis using Newman's Error Analysis (NEA). The conclusion of this study is that students' mathematical concept understanding, who the subject of this study is still relatively low with a percentage of 24.2%. The percentage of students' mathematical concept understanding is still in the low category for the first and third indicators, and moderate for the second insdicator. So that the number of errors found in student answers to questions containing the first and second indicators is in the high category, while the second indicator is in the medium category. The mistakes made by students in this study were reading errors, comprehension errors, transformation errors, process skill errors, and encoding errors. The mistakes made by students in solving questions of multiplication operations were caused by their low ability to understand the concept of multiplication.

***Keywords:*** *error analysis, mathematical concept understanding, multiplication, elementary school*

## INTRODUCTION

In studying mathematics, students must be able to understand the concept of mathematics itself, not just memorize it. Without understanding mathematical concepts, students will experience difficulties in learning mathematics, have difficulty working on questions and find it difficult to apply them in everyday life.(Rismayanis et al., 2022). Understanding of mathematical concepts is one of the basic abilities that must be possessed by students. According to Norwich The Royal Institution Cambridge university and Homerton College, one of the 5 main skills that students must have to help students learn mathematics is conceptual understanding which includes understanding mathematical concepts, operations, and relationships. In the SI (Content Standards) for mathematics at all levels of primary and secondary education, it is explained that the first goal of mathematics is for students to be able to understand mathematical concepts, explain the interrelationships between concepts, and apply concepts or algorithms, in a flexible, accurate, efficient manner. and precise problem solving.

Understanding of mathematical concepts is the ability to understand comprehensive and functional mathematical ideas (Fahrudin, Zuliana, & Bintoro, 2018). Understanding of mathematical concepts is the ability to formulate problem strategies, apply simple

calculations, use symbols in presenting concepts and changing a form in studying mathematics (Rismayanis et al., 2022). With conceptual abilities students can understand, formulate, apply, and apply mathematical concepts both in solving mathematical problems given during mathematics learning or those they encounter in everyday life.

There are four basic numeracy skills that must be mastered by students in learning mathematics. The four basic abilities are the ability to operate addition, subtraction, multiplication, and division (Rifanti, Nasaruddin, & Rosyidah, 2021). These four basic abilities are abilities that will continue to be needed as long as students study mathematics. Therefore, students must master the concepts of these four basic operational abilities. Of the four basic skills, multiplication is one that requires more attention. Based on the results of observations of the experiences of researchers when teaching for one year at a junior high school in Kupang Regency, East Nusa Tenggara Province (NTT), Indonesia. Some students, both in grades 7, 8 and grade 9, have a very low understanding of the concept of multiplication with integers. Even to remember and understand the multiplication of positive numbers is still low. The researcher then conducted interviews with 3 teachers who worked in 3 different schools. Two teachers gave the same answer, that is, students had difficulty remembering and understanding the concept of multiplication. In addition, they also found that children had difficulty understanding integer arithmetic operations. This is supported by a statement from another teacher who said that children had difficulty understanding the concept of basic mathematical operations, one of which was related to integer arithmetic operations.

Students cannot solve multiplication arithmetic operation problems independently because they still need the help of others. The same results were also conveyed in a study conducted by Unaenah., et al (2022) that elementary school students in one of the schools have not mastered the basic multiplication table and have not understood the concept of multiplication with integers.

Understanding the concept of multiplication can be seen by analyzing the mistakes made by students. Student mistakes in working on questions can be an indication that students do not understand the concept of the material provided (Pradini, 2019). Based on indicators of understanding mathematical concepts, we can find out what students lack in understanding concepts, especially the concept of multiplication. Based on this, the researcher took the research title on the analysis of student errors in working on integer multiplication operations with the aim of knowing how far students' understanding of multiplication operations is and where the most common errors students make when working on multiplication operations are located.

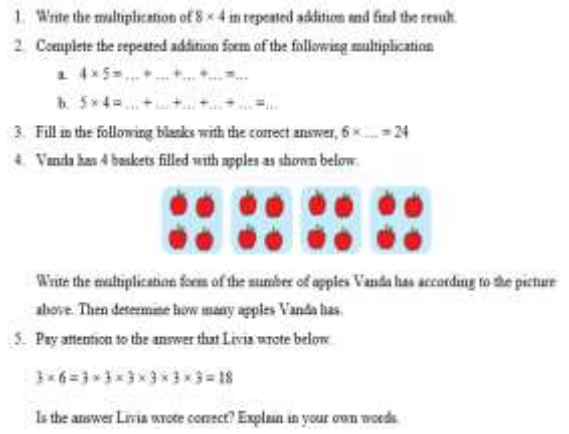
## METHODS

This research will use descriptive quantitative research methods. The data that has been processed will be analyzed by describing or illustrating or interpreting the meaning contained in the data that has been collected as it is without intending to make generalizations (Lestari & Yudhanegara, 2018). Students who have studied multiplication operations material will be given questions, then students' written answers will be processed using descriptive quantitative methods. Furthermore, some of the most prominent children's answers will be described to examine more deeply related to students' conceptual understanding of multiplication operations. The instrument used in this study was a written test instrument for understanding the concept of multiplication. Test instruments will be given to research subjects selected by purposive sampling technique. The research subjects were students who had received material on the concept of multiplication and multiplication operations so that

researchers could see where their mistakes were in working on the questions given and the extent to which they understood the concept of the material they had learned.

The research instrument was given to 57 students from two different elementary schools in Kupang Regency, East Nusa Tenggara. Data collection techniques, namely 1) Questions are given to students who have learned about multiplication concepts and arithmetic operations; 2) The data obtained is then calculated quantitatively to see the percentage of students' conceptual understanding abilities and the percentage of student errors 3) The percentage of students' conceptual understanding abilities and the percentage of student errors described according to the category of understanding mathematical concepts and errors students in working on questions and findings obtained from student answers.

The indicators of conceptual understanding used in this study are 1) restating mathematical concepts; 2) apply the concept algorithmically; 3) provide examples and non-examples of the concept (Mawaddah & Maryanti, 2016). These indicators are then represented in a matter of understanding the concept of multiplication concepts and operations. The following questions are used in this study.


1. Write the multiplication of 8 × 4 in repeated addition and find the result.
2. Complete the repeated addition form of the following multiplication
   a. 4 × 5 = ... + ... +... +... =...
   b. 5 × 4 = ... + ... +... +... + ... =...
3. Fill in the following blanks with the correct answer, 6 × ... = 24
4. Vanda has 4 baskets filled with apples as shown below.

Write the multiplication form of the number of apples Vanda has according to the picture above. Then determine how many apples Vanda has.

5. Pay attention to the answer that Livia wrote below.

3 × 6 = 3 × 3 × 3 × 3 × 3 × 3 = 18

Is the answer Livia wrote correct? Explain in your own words.

**Figure 1. Mathematical Concepts Understanding's Questions**

The first indicator is represented by questions 1 and 2, the second indicator is represented by questions 3 and 4, and the third indicator is represented by question number 5. The concept understanding category used in this study is the concept understanding category of Hakim (2020), which can be seen in Table 1.

**Table 1. Categories of Ability to Understand Mathematical Concepts**

| Criteria Value (X) (%) | Criteria |
|---|---|
| $X \geq 65.17$ | High |
| $31.50 \geq X \geq 65.17$ | Moderate |
| $X < 31.50$ | Low |

Analysis of student errors in this study used Newman's Error Analysis (NEA) with 5 categories of errors, namely Reading Error (student errors in reading a given mathematical problem and to identify and understand the sentences and symbols used), Comprehension Error (student errors in understanding a given math problem), Transformation Error (student error in choosing a method or formula, or the right solution to solve a given math problem), Process Skill Error (student error in conveying or describing the process of solving a math problem), Encoding Error (student error in expressing the final answer)(Abdullah, Abidin, & Ali, 2015). The criteria for the percentage of student errors in working on questions use the criteria from Pedai, Sulistiawati, & Arifin (2021). These criteria can be seen in Table 2.

**Table 2. Student Error Criteria**

| Percentage (P) | Criteria |
|---|---|
| $0\% < P \leq 20\%$ | Very low |
| $20\% < P \leq 40\%$ | Low |
| $40\% < P \leq 60\%$ | Moderate |
| $60\% < P \leq 80\%$ | High |
| $80\% < P \leq 100\%$ | Very high |

## RESULT AND DISCUSSION

The data that has been obtained, then processed descriptively, to see the percentage of the number of students who can answer questions about understanding the mathematical concepts of concept material and multiplication operations correctly. From these percentages, the percentage of the number of students who made mistakes on each indicator was obtained. The following presents the results of the calculation of the data obtained.

**Table 3. Percentage of Students' Concept Understanding Ability**

| Class | Restate mathematical concepts (%) | Applying concepts algorithmically (%) | Give examples and non-examples of concepts (%) |
|---|---|---|---|
| IVa | 5 | 53 | 5 |
| Va | 9,4 | 68.8 | 0 |
| IVb | 19.0 | 45,2 | 9,5 |

**Table 4. Percentage of Overall Students' Concept Understanding Ability**

| Indicator | No Question | The number of students who answered correctly | Percentage (%) | Category |
|---|---|---|---|---|
| Restate mathematical concepts | 1 | 2 | 11,4 | Low |
| | 2 | 11 | | |
| Applying concepts algorithmically | 3 | 45 | 56 | Moderate |
| | 4 | 18 | | |
| Provide examples and non-examples of concepts | 5 | 3 | 5,3 | Low |
| Percentage of Ability to Understand Mathematical Concepts | | | 24,2 | Low |

The ability to understand students' concepts in solving multiplication problems is explained as follows. Overall the ability to understand students' mathematical concepts is in the low category with a percentage of 24.2%. The first indicator restated the mathematical concept, the percentage of students who answered correctly was 11.4% with the percentage for each class namely class IVa by 5%, class V by 9.4% and class IVb by 19.0%. The second indicator applies the concept algorithmically, the percentage of students who answered correctly was 56%, with the percentage for each class namely class IVa of 53%, class V of 68.8%, and class IVb of 45.2%. The indicators are giving examples and non-examples of concepts, the percentage of students who answered correctly is 5.3%, with the percentage of each class, namely class IVa, is 5%, class V by 0% and, class IVb by 9.5%. In other words, for the first indicator, the number of students who made mistakes was 89.6%, the second indicator was 44%, and the third indicator was 85.7%. Based on the criteria for student errors by Pedai, Sulistiawati, and Arifin (2020) which can be seen in Table 2., student errors in indicator 1 and indicator 3 are classified as very high, and for indicator two it is classified as moderate.

Here are some examples of errors in understanding the concept of multiplication made by students.

### Error in Indicator 1

***Reading Errors & Encoding Errors***

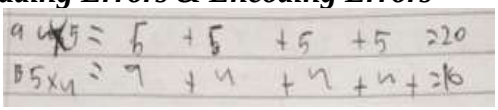


**Figure 2. Error in Indicator 1**

In question number 2 for indicator 1, students are asked to write down the repeated addition of the given multiplication. In the questions, instructions have been given to students by writing down how many times the addition has been repeated from the multiplication. However, students still make mistakes where students are not aware of the purpose of giving these symbols so that students make mistakes in working on this problem. This has an impact on the final answer written by the student, in which the student writes the answer 16 for multiplication 5 × 4 (Encoding Error).

***Comprehension Error***

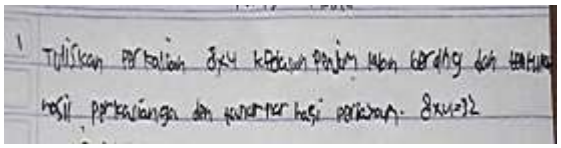


**Figure 3. Error in Indicator 1**

In question number 1 indicator 1 (Figure 3), students made a mistake in understanding the meaning of the problem given, including in terms of writing and explaining what was known and asked about the problem given. It can be seen from the student's work, in which students do not work according to the orders given and immediately write down the final results.

***Transformation Error***

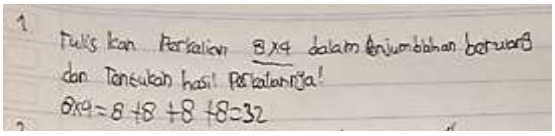


**Figure 4. Error in Indicator 1**

In Figure 4, it can be seen that students have not been able to translate or write the 8 × 4 multiplication form into the repeated addition mathematical model. The answers given are correct however, the mathematical model of repeated addition that is written is not quite right. Students should write down 8 × 4 = 4 + 4 + 4 + 4 + 4 + 4 + 4 + 4 = 32

***Process Skill Error***

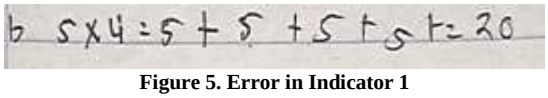


**Figure 5. Error in Indicator 1**

In this answer (Figure 5), it can be seen that students are able to read the intent of the questions and instructions given, so students know that this addition is repeated addition 5 times but in the process of solving it, students are fooled so students make mistakes. Students should write down 5 × 4 = 5 + 5 + 5 + 5 + 5 = 20

**Error in Indicator 2**

***Reading Error, Comprehension Error,* and Transformation Errors**

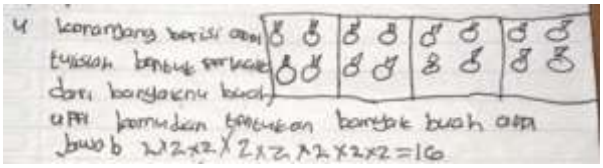
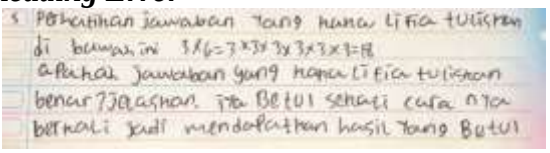


**Figure 6. Error in Indicator 2**

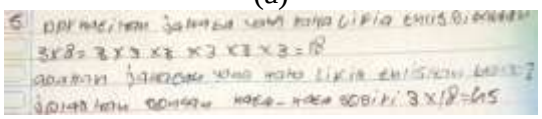
Students experience errors in reading and understanding the purpose of the problems given. It can be seen in Figure 6. Students are asked to write down the repeated multiplication of the number of apples in the basket. Students are not precise in understanding the illustrations given so students make mistakes in the process. In question number 4 indicator 2, 4 apples in a basket do look like they are arranged in an orderly manner, two in the first row and two in the second row. This is what makes students misunderstand the meaning of the illustrations given so that students make mistakes (Reading Error). Students write the multiplication form but the multiplication form that is written is not quite right. Students make mistakes in understanding the problems given (Comprehension Error),

**Error in Indicator 3**

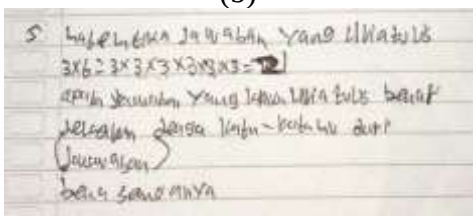
***Reading Error***



(a)



(b)



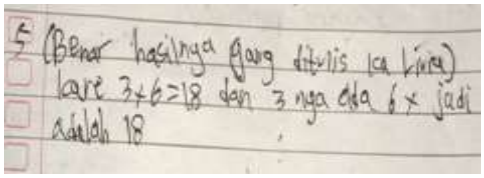
(c)

**Figure 7. (a), (b), and (c). Error in Indicator 3**

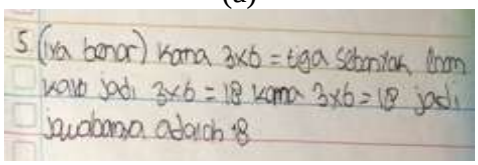
In indicator 3 (Figure 7. (a), (b), and (c)) the errors that occur are Comprehension Errors.

Students make mistakes because students do not understand the problems given, then students are also not precise in writing and explaining what is known and asked in the questions. So that in the end the students could not complete the questions given and immediately gave the answers, the answers given by the students were not quite right, the students could not show the completion process properly, and did not give the right conclusions.

***Process Skill Error***




(a)




(b)

**Figure 8. (a) and (b). Error in Indicator 3**

It can be seen in Figure 8. (a) and (b) that students make mistakes in the process. Students have not been able to carry out work procedures correctly. Students know that 3 × 6 is 18, but when explaining about the location of the error in the given problem, students are deceived by the questions and the final results, so that the solutions written by students are wrong. The conclusions from the problems given by students are also wrong.

The high percentage of errors made by students in working on questions can be caused by students' low conceptual understanding of a material. From the students' answers that have been displayed it can be concluded that students have the ability to understand concepts that are still lacking. A good understanding of concepts will help students to be able to solve mathematical problems given correctly, and vice versa. In line with what was stated by Azka & Martila (2022) that the cause of the occurrence of workmanship errors made by students because of the weak mastery of students' concepts of a material. When students have not been able to understand the questions or material provided, students will experience difficulties so that students can make mistakes both in using concepts and mistakes in solving a problem, conversely if the concept is well understood by students, then students are able to solve mathematical problems and are able to apply learning in everyday life (Nurikawai, Sagita, & Setiyani, 2021). Understanding of concepts influences students' ability to solve mathematical problems correctly, the better students' understanding of concepts, the better students solve mathematical problems (Hakim, 2019).

## CONCLUSION

Overall, the ability to understand mathematical concepts of students who are the subject of this study is still relatively low with a percentage of 24.2%. The percentage of students' conceptual understanding abilities is still in the low category for the first and third indicators, and moderate for indicator 2. So that the number of errors found in student answers is in questions that contain the same and second indicators in high categories, while for the second indicator the processing errors are included in medium category. The mistakes made by students in this study were reading errors, comprehension errors, transformation errors, process skill errors, and encoding errors. The mistakes made by students in solving questions on understanding the concept of the concept material and multiplication operations were caused by the low ability to understand the concept.

***Declaration by Authors***

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