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Division Learning Challenges: Error Analysis of Elementary Students in Solving Merdeka Curriculum Assessment

Gurit Wulan Jagadianti

Department of Mathematics and Natural Science, Universitas Negeri Surabaya, Indonesia
Correspondence E-mail: gurit.23005@mhs.unesa.ac.id

ABSTRACT

The aim of this study was to analyze elementary school students' errors in learning division under the Merdeka Curriculum on a public elementary school in Bojonegoro. The urgency of this study stems from the critical need to address students' recurring errors in basic mathematical concepts, which, if uncorrected, may persist to higher education levels. Employing a qualitative descriptive approach, data from 29 fourth-grade students were analyzed using Newman's Error Analysis. The results showed that the majority of errors occurred in comprehension, transformation, and process skills, each stemming from distinct causes and showing varying levels of interrelation. These errors highlight the importance of focusing on understanding the underlying mathematical process skills so that students can not only answer questions correctly but also apply the correct steps to solve math problems accurately. Identifying these errors is crucial to prevent their accumulation and to establish a strong mathematical foundation from an early age. This study emphasizes the need for tailored instructional strategies to address these errors, such as integrating real-world contexts into division exercises and offering focused remediation programs. Such approaches not only improve students' problem-solving skills but also enhance their readiness for more complex mathematical concepts in higher education.

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1. INTRODUCTION

Mathematics is a combination of concepts, skills, and facts steeped in abstract representations. Pasandaran & Mufidah (2020) asserts that to successfully learn mathematics, a gradual process of constructing systematic understandings of concepts is necessary. However, often in school learning, the focus tends to be on rules, procedures, and formulas to attain correct answers rather than comprehending the fundamental concepts. Simply teaching procedural skills to students may lead to difficulties in problem-solving and applying concepts in broader contexts (Mulyono, 2018). This creates a gap in conceptual understanding, thereby resulting in errors or misunderstandings when solving mathematical problems.

According to Muzangwa & Chifamba (2012), misconceptions are a subset of errors, meaning one can define all misconceptions as errors, but not all errors can be considered misconceptions. Newman (in Hadaming & Wahyudi, 2022) classified types of errors as follows: reading error; comprehension error; transformation error; process skill error; and encoding error. White (2005) explains each type of error as follows: 1) Reading error occurs when a student cannot read keywords or symbols written in a problem; 2) Comprehension error occurs when a student can read all the words in the problem but fails to understand the entire question, thus unable to estimate the steps needed to find a solution; 3) Transformation error happens when a student understands the question but cannot determine the correct operation or sequence of operations required to solve the problem; 4) Process skill error occurs when a student knows the sequence of operations required in solving a problem but does not know the proper procedure to execute the operations to solve the problem; 5) Encoding error occurs when a student is able to work through a problem to find a correct solution but fails to draw a conclusion or draws an incorrect one.

Many students make mistakes when answering mathematics tests (Schleppenbach *et al.*, 2007). Students' mistakes mostly occur due to individual problem-solving strategies and rules from previous class experiences (Salsabilah & Rahaju, 2022; Fardiana *et al.*, 2023; Malikha & Amir, 2018). Moreover, students' mismatch with teaching techniques employed by teachers can also be a cause of student errors. According to Rittle-Johnson & Alibali (1999), students' errors often tend to be systematic. These systematic errors stem from students' misunderstandings, including failures to connect their prior knowledge from previous classes with the new knowledge they acquire. In many instances, students link new knowledge with old knowledge but with a misunderstanding (Badjiser *et al.*, 2021; Duwila *et al.*, 2022; Nasir *et al.*, 2022). In their effort to grasp new knowledge, students might apply patterns or procedures they previously acquired to new situations or problems without considering possible contexts or differences. Another possibility is that students overly focus on a specific rule, leading them to fail in considering other alternatives in their understanding of a topic. Unless pedagogical actions are taken or interventions performed by teachers, some of these errors may persist for a very long time.

Therefore, errors need to be identified early at the elementary school level. This stage marks the initial phase in mathematics learning, where students establish the foundational understanding for key mathematical concepts (Tong *et al.*, 2021). Identifying errors at the elementary school level helps prevent the accumulation of mistakes or misunderstandings that could persist into higher levels of education. Moreover, it aims to ensure a strong foundation and accurate understanding of mathematical concepts. Students will have a better chance to comprehend and master more complex mathematical concepts in the future. Thus, early identification of errors in elementary school is not just about addressing

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individual mistakes but also about building a sturdy foundation and ensuring a correct understanding of mathematics, which is crucial for students' academic success in higher education levels.

One of the fundamental concepts that often poses difficulties for students is division (Mukminah *et al.*, 2021). The primary challenges in division learning include using mathematical symbols that represent the division process and understanding the associated rules. For instance, comprehending how to arrange division with remainders or applying the steps of long division algorithms can be complex and require more time and practice than some other mathematical topics. Nurfitasari et al. (2023) revealed in their research that division learning not only requires an understanding of the fundamental division concepts but also the systematic application of specific rules. This process demands students to grasp the basic concepts of division, master the involved mathematical symbols, and train themselves to correctly apply the steps of division algorithms.

The identification of elementary school students' errors in division is based on the understanding that this mathematical concept often presents obstacles for some students. Various previous studies have shown recurring patterns of errors, such as difficulties in understanding the basic concepts of division, errors in calculation processes, or limited comprehension of the relationship between division and other mathematical operations (Hadaming & Wahyudi, 2022; Azis *et al.*, 2021). This discussion is supported by the need to identify commonly experienced errors by students, comprehend their root causes, and discover more effective learning solutions. The outcomes of this discussion not only aid in highlighting common errors but also support the development of more targeted learning approaches. With a better understanding of where errors frequently occur, teachers can design better strategies to teach division concepts, introduce more suitable methods to help students overcome errors, and develop curriculum more responsive to students' needs in understanding division concepts.

2. METHODS

This research is classified as qualitative research employing descriptive methods. Data were collected from 29 fourth-grade students during the 2023/2024 academic year at a public elementary school in Bojonegoro Regency. The data collection technique involved a test consisting of four multiplication and division questions adapted from the Mid-Semester Summative test. Additionally, interviews were conducted with students and their teacher to gain deeper insights into their understanding of the taught material, the errors they made, and the methods they used to answer these questions.

The data obtained from the test results and interviews were then analyzed using Newman's Error Analysis. The data analysis process comprised three main steps. There are data reduction, data presentation, and drawing conclusions. This approach allowed the researcher to comprehend students' errors and strategies, providing a comprehensive overview of how students learn and understand multiplication and division concepts.

3. RESULTS AND DISCUSSION

3.1. Result of Error in Student's Answer

The errors were analyzed from 29 fourth-grade students at a public elementary school in Bojonegoro Regency. From the results of the Mid-Semester Assessment for the 2023/2024 academic year in mathematics, there were several incorrect answers given by the students.

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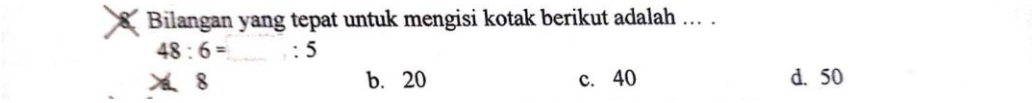
However, the questions with the most incorrect answers were related to division material. There were 28 students who answered the following question incorrectly, see **Figure 1**.

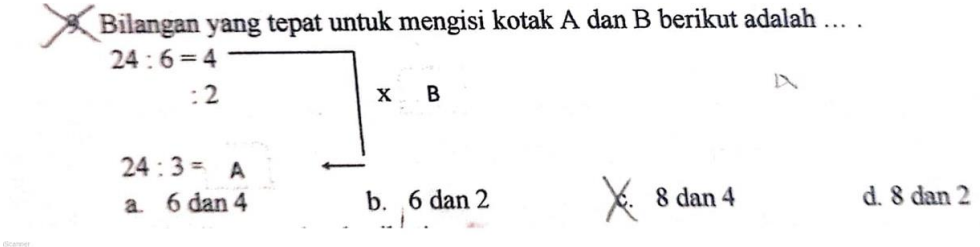


Translation:
The correct number to fill in the following box is ….

Figure 1. Incorrect Answer for Question Number 8

Based on the interview conducted with the teacher, students tended to choose answer a) because they considered the question to be a regular division problem. The students did not understand the comparison aspect of the question, which resulted in answers that did not satisfy the correctness of the division comparison. The students thought that the correct number to fill in the box was obtained from dividing 48 by 6. They did not understand the division by five symbols on the right side of the box, which indicated that the question referred to a division comparison.

Additionally, there was another question with the most incorrect answers, also related to division material. Only 5 students were able to solve this question correctly. Here is another question that had the most incorrect answers.



Translation:
The correct number to fill in the A box and B box is ….

Figure 2. Incorrect Answer for Question Number 9

In the question shown in **Figure 2**, the issue presented revolves around division comparison. Most students answered that the correct numbers for A and B were c) 8 and 4. When students were asked the reason for choosing this answer, they identified the relationship between the numbers based on basic division principles. They observed that dividing 24 by 3 yields 8, which they assumed to be number for A. Next, they inferred that dividing number for A by 2 would give them number for B. Following this logic, they calculated that 8 divided by 2 equals 4, thereby determining number for B as 4.

Furthermore, in another division-related question, it appears that some students have not mastered long division. This is shown by the students' answers in **Figure 3**, which did not require reasoning, but the students' answers demonstrated calculation errors. The errors suggest that the students applying incorrect procedures or failing to carry out the steps of long division accurately.

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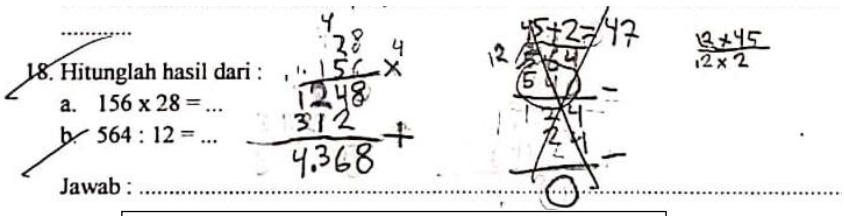

Translation:
Calculate the result of: a) 156×28; b) $564 \div 12$

Figure 3a. Incorrect Answer of Student A for Question Number 18b

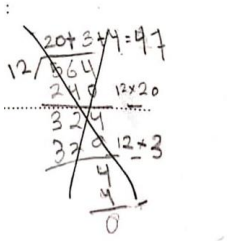

Figure 3b. Incorrect Answer of Student B for Question Number 18b

From **Figure 3a** and **Figure 3b**, it is evident that the students have not fully mastered the division material. Both answers indicate errors in the initial stages of division using the stacking method. Students understand how to correctly place the dividend and divisor, but there are mistakes in the calculation process. In **Figure 3a**, student A made a mistake in multiplying the divisor, resulting in an incorrect quotient. Meanwhile, in **Figure 3b**, student B made a mistake in subtracting the dividend by the product of the divisor and quotient. In both students' answers, errors in the calculation process are apparent.

To ensure consistency and credibility in assessing student errors, another test was conducted by administering a mathematics test focusing on division-related topics. The test sheet consisted of 4 essay questions. The first question dealt with division rules, the second with division comparison, the third with long division, and the fourth with word problems related to division. These four questions were given to 29 students in the same class as the Mid-Semester Assessment.

From the test results, the data of 29 students with correct and incorrect answers are outlined in the following **Table 1**.

Table 1. Frequency of Incorrect and Correct Answers by Students

Type of Question	Frequency of Student	
	Incorrect Answers	Correct Answers
Division Rules	29	-
Division Comparison	29	-
Long Division	17	12
Contextual Problems of Divison	19	10

Table 1 shows that students tend to make errors in division rule questions, division comparison questions, and word problems involving division. Moreover, less than 50% of students answered long division questions correctly. This indicates that there are still many mistakes in students' answers regarding division problems. Based on the frequency of incorrect answers in **Table 1**, students' responses were then grouped according to Newman's Error Analysis to identify trends in the errors they made. Here is a **Table 2** student errors classified according to Newman's Error Analysis.

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Table 2. Students' Error Category

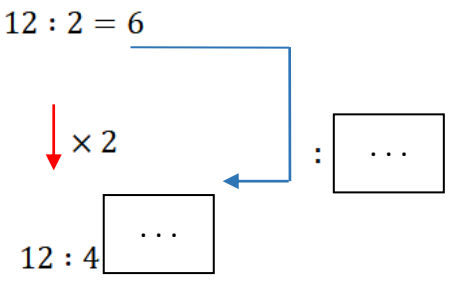
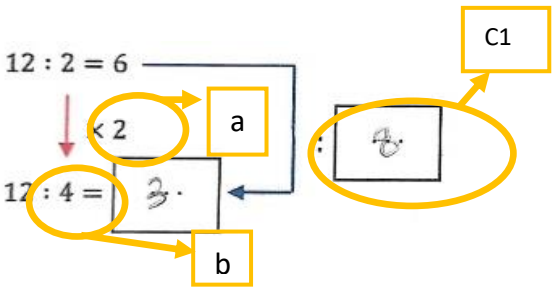
Error Category	Frequency of Student			
	Question 1	Question 2	Question 3	Question 4
Reading Error	-	-	-	-
Comprehension Error	29	29	-	9
Transformation Error	-	-	3	10
Process Skill Error	-	-	14	-
Encoding Error	-	-	-	-
Total	29	29	17	19

In **Table 2**, most students are indicated to have comprehension errors in question 1 and 2, process skill errors in question 3, and transformation errors in question 4. Based on data, the errors observed are not just in the final answers provided by students, but also in their ability to read, comprehend, and execute the steps or procedures required to solve mathematical problems. A more detailed discussion will be outlined as follows.

3.1.a. Comprehension Error

Errors in understanding the problem can be identified from what is being asked and the meaning of a question. According to Newman's Error Analysis, errors may occur because students are unable to grasp the entirety of a question, thus failing to estimate the necessary steps for solving it. **Table 3** illustrates examples of comprehension errors among elementary school students regarding division material.

Table 3. Students' Error Category

Question	Students' Answers
Write the correct number to fill in the box below and the method to solve it!  	

From **Table 3**, it is evident that students were unable to correctly answer the blank column. Through interviews conducted, it was found that students obtained C1 from multiplying 2 and 4 (denoted as a and b). The students merely guessed the relationship between the numbers in the question to find a solution for the blank box. This occurred because the students did not know or understand the method for solving the problem, resulting in C1 being obtained from multiplying number a by number b. Therefore, students are indicated to have errors in comprehending the questions provided.

Another example of comprehension error in elementary school level division problems is illustrated in **Table 4**. In the example provided by **Table 4**, the division problem is a

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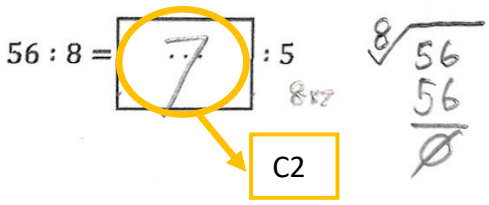
comparison where the result of division on the left side must equal the result of division on the right side.

Table 4. Example of Comprehension Error on Question 2

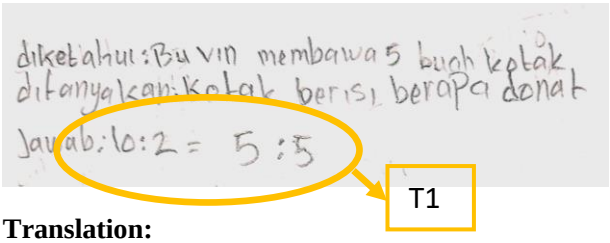
Question	Students' Answers
Write the correct number to fill in the box below and the method to solve it! $56 : 8 =$ ...	

In the students' written answers **Table 4**, they used long division to solve the problem. This indicates that the students provided answers based on the direct result of dividing 56 by 8. Furthermore, during the interview session, students explained that answer C2 was obtained from 56 ÷ 8. However, when asked about the division by 5 on the right side, students were confused in providing an answer. This shows that students did not understand that the division by 5 on the right side meant a comparison. They overlooked the division symbol for 5 and only answered based on the result of dividing 56 by 8. From the students' answers, it can be indicated that they had difficulty understanding the problem being asked. They struggled to estimate the steps needed to find the correct solution.

3.1.b. Transformation Error

Errors made by students in transforming problems are shown in their inability to determine the appropriate operation or sequence of operations needed to solve the given problem. Additionally, transformation errors can be demonstrated through mistakes in selecting formulas, errors in problem-solving, and errors in developing mathematical models based on the information in the problem. An example of a transformation error made by students in a division problem is shown in **Table 5**.

Table 5. Example of Transformation Error on Question 4

Question	Students' Answers
Mrs. Vin brought 5 boxes of donuts to be shared with 10 children. Each box contains a certain number of donuts. If each child gets 2 donuts, how many donuts are there in each box?	 **Translation:** Known: Mrs. Vin brought 5 boxes Question: How many donuts are in the box? Answer: 10 : 5 = 5 : 5

In **Table 5**, it is apparent that the student only writes down one known fact and the question from the problem. However, the student does not provide further explanation regarding what the numbers used in the mathematical model (T1) represent in the problem. The student makes a mistake in planning the problem-solving process or selecting the

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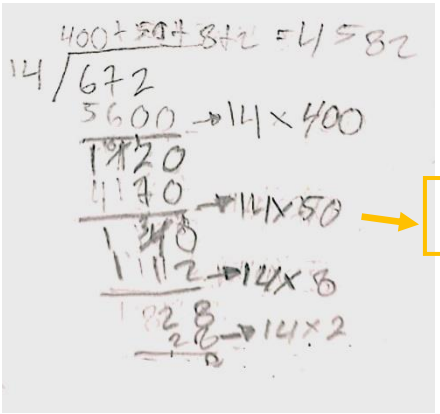
procedure to find the solution to the given question. The error in T1 shows that the student's mistake cannot help answer the problem correctly.

3.1.c. Process Skill Error

Students who are indicated to have made process skill errors are those who understand the problem, know the correct operation or sequence of operations to solve the problem, but do not know the procedure or make mistakes in performing the calculations. Process skill errors are evident in students' mistakes in using formulas, errors in mathematical calculations, and errors in algebraic manipulation. This is consistent with research conducted by Hadi, et al. (2018), which states that the most common error made by students in all test questions is process skill error.

One example of a process skill error by elementary school students in division material is shown in **Table 6**. The error made by the student starts from P1, which is a minor calculation mistake that affects the entire final answer.

Table 6. Example of Transformation Error on Question 3

Question	Students' Answers
Calculate the result from: $672 : 14 = \cdots$	

From **Table 6**, it is apparent that the student made an error in multiplying 14 and 50, resulting in 70. The student actually understood the question posed. This is evident from the student's ability to transform the given problem into a mathematical model, but the student made a mistake during the multiplication operation. This error shows that the student still struggles with multiplication and division operations, even on simple problems.

3.2. Discussion of Error in Student's Answer

Based on the data analysis, it is evident that the errors made by elementary school students in division problems are primarily comprehension, transformation, and process skill errors. This aligns with the research by Kristianti & Retnawati (2020), which mentions that most student errors are in comprehension, where students are indicated to not understand the problem or question posed, making it difficult for them to estimate the correct procedure for solving it. From the data analysis based on Newman's procedure, no reading errors were found in the students' mistakes. This is consistent with the research by Abdullah et al. (2015), which found that students do not have difficulty reading the

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problems in the questions. Students tend to face content difficulties rather than language difficulties in solving math problems.

The majority of the errors made by students are due to difficulties in understanding the information presented in the questions. Common errors point to comprehension issues where students are still confused when faced with problems involving division rules, comparisons, and word problems. Understanding the problem is crucial for finding the correct solution. This is supported by Rahardjo & Waluyati (2011), who state that students cannot solve problems correctly without understanding the problem posed. From interviews with teachers, another reason why most students provide incorrect answers on division questions is that prerequisite material from previous grade levels was not delivered effectively, making it difficult for students to grasp new material at the current level.

Other errors were also frequently found in the process and transformation stages. Data analysis showed that students made mistakes in applying multiplication or subtraction rules in division problems. These include errors in multiplying or subtracting numbers, correctly understanding mathematical operations, or remembering basic calculation rules. These errors highlight the need to focus on understanding the underlying mathematical process skills so that students can not only answer questions correctly but also apply the correct steps to solve math problems accurately. This is related to the students' conceptual understanding. Similarly, the research by Agustyaningrum et al. (2018) shows that the most dominant errors made by students are conceptual errors. When students' understanding of concepts is lacking, they will have difficulty operating or solving a problem.

Correcting errors in division for elementary school students is a crucial step in fostering a solid understanding of mathematical concepts. Teachers play a critical role in addressing students' errors in learning mathematics. The initial step in this alternative solution is identifying common errors or misunderstandings among students, such as difficulties in understanding division with remainders or long division algorithms. After identification, teachers can adopt strategies that focus on the types of errors students make and then provide more individualized approaches for each student. For example, through more detailed explanations, mathematical manipulatives, or using more visual learning methods, students can be guided to better understand the steps involved in division. Repeating exercises and providing real-life situations where division is needed also helps students internalize this concept. The importance of remediating division errors is not only to correct students' mistakes but also to build a strong foundation in mathematics that will impact their understanding of more complex mathematical concepts in the future.

Furthermore, teachers' ability to address students' division errors is crucial in determining the effectiveness of instruction. A skilled teacher must have a deep understanding of the concept and the ability to detect and identify errors that students might have. Flexibility in teaching approaches is also essential; a teacher who can use various teaching strategies, including visual approaches, real-life examples, manipulatives, and supportive technology, will be more effective in helping students grasp the concept of division. Additionally, the ability to create an open, supportive classroom environment that motivates students to ask questions and discuss errors is also crucial. Teachers who can provide constructive feedback, encourage collaboration with parents, and conduct periodic evaluations of students' progress in addressing errors will be key to successful learning. The ability to personalize the learning approach according to the individual needs of students is also a significant advantage for a teacher in correcting errors.

Based on the above explanation, the primary alternative solution is to repeat exercises and provide real-life situations where division is needed. This helps students strengthen

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their understanding of the division concept. This approach is also supported by providing a variety of question types to sharpen students' abilities and skills in solving division-related problems.

4. CONCLUSION

Based on the analysis of student errors in learning division in elementary school, it can be concluded that the majority of student errors occur in comprehension errors, transformation errors, and process skill errors. This indicates that students have difficulties in understanding the problem, determining the correct operation, and performing calculations. These errors highlight the need to focus on understanding the underlying mathematical process skills so that students can solve problems accurately. Additionally, the most dominant errors made by students are conceptual errors. Therefore, identifying these errors is crucial to prevent the accumulation of mistakes or misunderstandings that can persist to higher education levels. Thus, it is important to provide further assistance to students in understanding and solving math problems and to build a strong foundation to ensure correct mathematical understanding from an early age in elementary school. An alternative solution that can be used is to provide practice and real-life situations where division is needed.

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