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Analysis Of Students' Learning Difficulties In Completing Basic Mathematical Operations In State Elementary School 117/II, Bungo District

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Abstract

Basic arithmetic operations are the main foundation in numeracy literacy of elementary school students. However, difficulties in mastering this concept remain a persistent phenomenon, especially in areas with specific socio-educational characteristics. This study aims to analyze error patterns and factors causing students' learning difficulties in completing basic arithmetic operations (addition, subtraction, multiplication, and division) at SD Negeri 117/II, Bungo Regency. This study uses a descriptive qualitative approach with a case study design. The research subjects consisted of 15 students in grades IV, V, and VI selected through a questionnaire.purposive samplingbased on the results of the initial diagnostic test, as well as 3 class teachers and 3 parents of students. Data collection instruments included error analysis tests (adopting the Newman procedure), semi-structured interviews, and learning observations. Data were analyzed using the interactive model of Miles, Huberman, and Saldaña. The results of the study showed that (1) the dominant errors of students were transformation errors and computational process errors, where students understood the concept but failed to execute the algorithm correctly; (2) in multiplication and division operations, students experienced conceptual misconceptions, considering division simply as the inverse of multiplication without understanding the meaning of partitions and quotas; (3) internal factors causing difficulties included low long-term memory retention of basic facts (multiplication tables) and math anxiety (math anxiety); (4) external factors include the dominance of drill methods without concrete media, as well as low numeracy literacy among

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parents in the agrarian environment of Bungo Regency which results in minimal academic support at home. This study recommends the implementation of the approach Concrete-Representational-Abstract (CRA) and differentiated learning in accordance with the spirit of the Independent Curriculum to address conceptual misconceptions.

Keywords: ***Learning Difficulties, Basic Operations, Newman Error Analysis, Numeracy, SD Negeri 117/II Bungo.***

INTRODUCTION

Mathematics is a universal discipline and plays a vital role in developing students' logical, analytical, and systematic thinking skills. At the elementary school level, mastery of basic arithmetic operations—including addition, subtraction, multiplication, and division—is an absolute prerequisite for continuing mathematics learning at the next level and is a key indicator of numeracy literacy. The Minimum Competency Assessment (AKM) in Indonesia and global assessments such as Programme for International Student Assessment (PISA) consistently shows that Indonesian students' numeracy skills remain at a concerning level (OECD, 2023; Rahayu et al., 2022). This low numeracy achievement stems from a weak mastery of basic arithmetic operations in the foundation and transition phases of elementary school.

Difficulties in learning mathematics in basic arithmetic operations are not simply a matter of inability to calculate, but rather a cognitive complexity that involves understanding concepts, memorizing basic facts, and executing algorithms. Students often experience what are known as misconceptions, where they are able to follow algorithmic procedures mechanically but fail to grasp the mathematical meaning behind the operations (Sari & Prahmana, 2021). For example, in the operation of subtraction, students often make mistakes in the concept of "borrowing," which is actually related to understanding place value. These procedural and conceptual errors will accumulate and become significant cognitive barriers when students face more complex mathematical materials such as fractions, algebra, and geometry (Hidayat et al., 2020).

This difficulty is exacerbated by specific environmental and pedagogical contexts. In semi-rural areas or districts like Bungo Regency, the challenges of mathematics education have their own unique dynamics. The socioeconomic characteristics of the community, which predominantly works in the agricultural and plantation sectors, often correlate with low levels of parental numeracy literacy, which results in minimal support for learning at home (Mulyani, 2020). Furthermore, pedagogical practices in the classroom are often still teacher-centered with the

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dominance of the drill method and repetitive practice questions without adequate manipulative or concrete media to bridge the concrete operational stage of elementary school students (Supriadi, 2021). The transition to the Independent Curriculum, which emphasizes in-depth understanding and numeracy literacy, requires this paradigm shift, but its implementation in the field often faces challenges related to teacher preparedness and the availability of learning resources (Pratama & Wardana, 2023).

SD Negeri 117/II, Bungo Regency, is one of the schools facing this classic yet crucial problem. Based on initial observations and daily test results, more than 60% of students in upper grades (IV, V, and VI) still make fundamental errors in solving complex arithmetic operations, complex multiplication, and division. Teachers often dismiss these errors as ordinary negligence, even though in-depth analysis is needed to identify whether the errors stem from ignorance of basic facts, misconceptions about place value, or affective factors such as math anxiety (Vamvakoussi, 2022).

Several previous studies have examined Newman's error analysis in arithmetic operations. However, research that specifically integrates cognitive error analysis with socio-cultural factors of the school environment in districts like Bungo is still very limited. Integrating these dimensions is crucial because cognitive errors in mathematics are not merely mental miscalculations, but are often manifestations of unaligned socio-cultural practices and pedagogical approaches in rural settings. This study fills this gap by not only mapping the types of errors based on Newman's procedure, but also comprehensively analyzing the internal (cognitive and affective) and external (pedagogical and environmental) factors that underlie them. Therefore, this study aims to: (1) analyze the patterns and types of student errors in completing basic arithmetic operations; (2) identify internal and external factors that cause learning difficulties; and (3) formulate pedagogical implications for improving mathematics learning at SD Negeri 117/II, Bungo Regency.

METHOD

This research uses a qualitative approach with a case study design to explore in depth the phenomenon of students' learning difficulties in basic arithmetic operations. A qualitative approach was chosen because it allows researchers to understand the meaning, context, and cognitive processes behind students' errors, which cannot be measured solely through quantitative figures (Creswell & Creswell, 2022).

Research Setting and Subjects. The research was conducted at SD Negeri 117/II, Bungo Regency, Jambi Province, during the odd semester of the 2024/2025 academic year. The location

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was selected based on the consideration that this school represents the characteristics of elementary schools in semi-rural areas with unique numeracy challenges. The research subjects consisted of 15 students in grades IV, V, and VI selected using purposive sampling. Subject inclusion criteria were students identified as having significant difficulties in basic arithmetic operations based on the results of initial diagnostic tests and recommendations from class teachers. In addition to students, the researchers also involved three class teachers and three parents as supporting subjects for triangulation of external factor data.

Data Collection Instruments. Data collection is carried out through three main techniques:

1. **Diagnostic Tests and Error Analysis:** This test is designed based on basic arithmetic operations (addition, subtraction, multiplication, and division) with a level of complexity tailored to the student's learning phase. Error analysis adopts and adapts a procedural framework of Newman's Error Analysis which includes: reading errors, comprehension errors, transformation errors, process skill errors, and encoding errors (Singh et al., 2020; Polya in a modern context).
2. **Semi-Structured Interview:** It is carried out on students to reveal the thinking process (think-aloud protocol) when completing questions, confirming the type of error, and exploring affective factors (such as anxiety). Interviews were also conducted with teachers to explore pedagogical strategies and with parents to map learning support at home.
3. **Observation:** Non-participant observation was conducted during the mathematics learning process to observe the use of media, teaching methods, and interactions in the classroom.

Data Validity. Data validity was tested using source and method triangulation. Test data were compared with student interviews and confirmed through classroom observations and teacher and parent interviews.

Data Analysis Techniques. Data were analyzed using an interactive model from Miles, Huberman, and Saldaña (2020) which consists of three activity flows: (1) Data condensation, where raw data from tests and interview transcripts are selected and categorized based on error type and causal factors; (2) Data display, which is presented in the form of a matrix, textual narrative, and error frequency table; (3) Drawing and verifying conclusions, where patterns of difficulty and root causes are comprehensively identified.

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RESULTS AND DISCUSSION

1. Analysis of Basic Arithmetic Operation Error Patterns

Based on the results of diagnostic tests and interviews analyzed using Newman's framework, it was found that student errors at SD Negeri 117/II, Bungo Regency, did not occur randomly, but rather had a systematic pattern. The distribution of errors across the five Newman indicators is summarized in Table 1.

Table 1. Distribution of Newman's Errors in Basic Arithmetic Operations (N=15)

Operation	Reading Error	Comprehension Error	Transformation Error	Process Skill Error	Encoding Error
Addition	2	3	5	6	2
Subtraction	1	2	7	8	1
Multiplication	1	2	6	10	3
Division	2	4	9	11	2

Overall, the most dominant errors occurred at the transformation and process skill stages, indicating that students generally understand the problem but fail to translate and execute the algorithm correctly.

Errors in Sequence Addition and Subtraction

In addition and subtraction operations, the main error made by students lies in understanding place value and the "borrow/save" algorithm.

1. **Empirical Evidence:** In the subtraction problem 402 - 135, 8 out of 15 students answered 333. The interview results showed that students made procedural errors in the units column (2 - 5), students borrowed from tens, but because tens had a value of 0, students failed to do regrouping to hundreds.
   [Figure 1. Student's work sample showing subtraction error in 402 - 135 = 333 due to place value misconception and failed regrouping from hundreds to tens]
2. **Analysis:** This error is not simply an oversight, but rather a conceptual misconception about place value. Students view the number 402 as a collection of independent digits 4, 0, and 2, rather than as 4 hundreds, 0 tens, and 2 ones. This aligns with the findings of Hidayat et al. (2020) who stated that a failure to understand place value is the root of 70% of basic arithmetic errors in elementary school.

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Errors in Multiplication and Division

Difficulty with multiplication and division indicates a higher level of complexity.

1. **Basic Facts:** 12 out of 15 students failed to memorize basic multiplication (1-10). As a result, they used repeated addition, which was very slow and prone to arithmetic errors.
2. **Division Misconceptions:** In the division problem 72:8, some students answered 9, but when asked "What is the meaning of 72:8?", the students were unable to explain it. More fatally, in the story problem: "Mother has 24 apples, which she will share equally among 4 children. How many apples will each child receive?", 5 students actually carried out multiplication operations (24 x 4 = 96).
3. **Analysis:** This transformation error indicates that students are unable to translate the linguistic concept (the word "divided") into a precise mathematical model. Students simply memorize keywords: "divided = divide," "total = times," without understanding the meaning of partition (division as group division) and quotation (division as measurement) (Sari & Prahmana, 2021).

Encoding Errors

Although less dominant compared to transformation and process errors, encoding errors (errors in writing the final answer) were still found, particularly in multiplication and subtraction operations. As many as 3 students in multiplication and 2 students in addition wrote the correct final computation result but failed to record it properly on the final answer line, or wrote the correct number but forgot to include the unit (e.g., "apple" or "kg"). Interviews revealed that these errors were strongly influenced by haste and math anxiety, where students rushed to finish the test due to time pressure and fear of being reprimanded, causing a disconnect between their cognitive results and their written output.

Internal Factors Causing Learning Difficulties

Students' learning difficulties cannot be separated from the internal conditions of the students themselves, which are divided into cognitive and affective aspects.

A. Long-Term Memory and Cognitive Deficits Basic arithmetic operations require automation of basic facts (such as multiplication tables). Students at SDN 117/II Bungo experience cognitive load which is excessive when working on stacked problems because they have to think about two things at once: the algorithm (how to borrow/save) and basic facts (the result of multiplying 7x8, etc.). According to cognitive load theory, when working memory is too full, information processing

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will fail (Sweller in Vamvakoussi, 2022). Students fail to execute algorithms because their cognitive capacity is exhausted to remember basic facts that have not been automated.

B. Cognitive Development and the Need for Concrete-Representational-Abstract (CRA) Transition The errors in the concepts of "borrowing" and "dividing" found in this study directly indicate a failure to transition from the enactive (concrete objects) to the iconic (pictures) and symbolic (numbers) stages. Elementary school students (aged 7-11) are in Piaget's concrete operational stage. They need manipulative objects to build abstract understanding. Recent research by Supriadi (2021) and Poliak et al. (2022) demonstrates that interventions using a Concrete-Representational-Abstract (CRA) approach can significantly reduce place value misconceptions and improve understanding of the concept of division. The absence of this transition in learning causes students to memorize procedures without conceptual foundation.

C. Math Anxiety In-depth interviews revealed the presence of symptoms of math anxiety. Student A (Grade V) stated, "I'm afraid if I'm asked to go to the blackboard, sir. If I get it wrong, my friends will laugh at me, so I'll forget how to count." This anxiety blocks students' access to their long-term memory. Negative affect toward mathematics makes students more likely to avoid tasks and be passive during learning, ultimately exacerbating their skill deficits (Ashcraft & Kirk, 2021).

3. External Factors Causing Learning Difficulties

External factors that influence students' learning difficulties at SDN 117/II Bungo Regency come from the pedagogical environment (school) and socio-cultural environment (home).

A. Pedagogical Practices and Lack of Concrete Media Classroom observations show that 2 out of 3 teachers still dominate learning with expository methods and drill (repeated work on questions in the textbook). The CRA approach, which is essential for elementary school students, has not been optimally implemented. Teacher B stated, "We've tried using media, but sometimes it's too time-consuming. It's quicker to just give the formula or a quick method so students can work on the exam questions quickly." This statement reveals administrative pressure and teachers' misconceptions about "learning speed." Teaching algorithms without a concrete foundation leads students to simply memorize procedures (procedural knowledge) without understanding their meaning (conceptual knowledge) (Supriadi, 2021; Pratama & Wardana, 2023).

B. Socio-Cultural Context and Parental Support Bungo Regency is characterized by a population that is predominantly employed in the palm oil plantation and agricultural sectors. This impacts parents' time and capacity to support their children. Parent C (a palm oil worker) explained, "I only finished elementary school, sir. If I'm told to tell my child to study, I tell him to read books. But if I

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ask him how to count, I've already forgotten, afraid I'll teach him wrong." The low literacy and numeracy of parents and the busyness of the economy create a learning gap at home. Students lack the space to discuss their difficulties or engage in simple mathematical explorations at home (Mulyani, 2020). This contradicts the principles of the Independent Curriculum, which emphasizes partnerships between schools and families in supporting differentiated learning.

DISCUSSION: THEORETICAL AND PEDAGOGICAL IMPLICATIONS

The findings of this study confirm that the difficulty of basic arithmetic operations in SD Negeri 117/II, Bungo Regency is a multidimensional problem rooted in conceptual misconceptions, fact automation deficits, and a less cognitively supportive learning environment.

The Ethnomathematics Gap: Informal vs. Formal Mathematics An ethnomathematics perspective reveals a critical gap between informal mathematics practiced in the agrarian daily life of Bungo and formal mathematics taught in school. Parents working in palm oil plantations and rubber estates actually engage in mathematical practices daily—calculating plantation area, estimating harvest yields, determining fertilizer doses, and computing income from rubber tapping. However, this informal ethnomathematics fails to transfer to formal school mathematics because the school curriculum does not acknowledge or bridge these everyday practices. The disconnection between the "mathematics of the plantation" and the "mathematics of the classroom" creates a cognitive dissonance for students, making school mathematics feel alien and irrelevant to their lived experiences. Addressing this gap requires teachers to intentionally integrate local agrarian contexts into mathematics lessons, transforming students' informal knowledge into a foundation for formal mathematical understanding (Puspitasari, 2022; Wulandari & Zulkardi, 2023).

Overcoming Cognitive Load and Math Anxiety through Gamification The fact that students experience cognitive load due to not having memorized the multiplication tables indicates the need for different teaching strategies. Boring traditional drill has been proven to trigger math anxiety (Ashcraft & Kirk, 2021). Schools need to implement mathematical games (gamification) and the use of simple technology (if available) or multiplication songs to build automation of basic facts in a fun atmosphere, thereby reducing students' negative affective responses (Nurhasanah et al., 2021). The Independent Curriculum provides teachers with the freedom to conduct Non-Cognitive Diagnostic Assessments to map students' psychological well-being and Cognitive Diagnostic Assessments to map skill deficits, so that interventions can be carried out precisely on target (Susanti & Widyawati, 2024; Rahayu et al., 2022).

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The Importance of Differentiated and Contextual Learning The socio-economic characteristics of parents in Bungo Regency require schools to go beyond simply assigning burdensome homework, as parents lack the capacity to assist. Instead, teachers need to design differentiated learning in the classroom. Students experiencing procedural difficulties require scaffolding that is more intensive, such as the use of illustrated worksheets (visual scaffolding) that guides the algorithm's steps step by step (Rahmawati, 2020; Hidayat et al., 2020). Furthermore, teachers should contextualize story problems within the local Bungo environment (e.g., calculating palm oil yields or distributing fertilizer) to make it easier for students to transform from language to mathematical models, as they are familiar with the context (Mulyani, 2020).

The Role of Teachers as Conceptual Facilitators These findings also highlight the importance of increasing Pedagogical Content Knowledge (PCK) of teachers. Teachers must not only know "how to count," but also "why students often make miscalculations" and "how misconceptions are formed." Teacher training programs at the KKG (Teacher Working Group) level in Bungo Regency should focus on error analysis and CRA intervention strategies, not simply administrative curriculum socialization. By understanding the root causes of errors, teachers can shift the paradigm from "blaming students for being careless" to "reflecting on teaching methods that do not fully bridge concepts" (Pratama & Wardana, 2023; Badaruddin & Nuryami, 2022).

CONCLUSION

This study concludes that students' learning difficulties in completing basic arithmetic operations at SD Negeri 117/II, Bungo Regency, are dominated by transformation errors and process skill errors, which are rooted in misconceptions of place value and the meaning of operations (especially division). The factors causing learning difficulties are multidimensional. Internally, students experience a deficit in basic fact automation that causes cognitive overload, as well as experiencing math anxiety that hinders information processing. Externally, the dominance of drill methods without concrete media in the classroom, as well as low numeracy literacy and limited parental time in the agrarian environment of Bungo Regency, exacerbate student learning barriers.

Based on these findings, several things are recommended: (1) Teachers are expected to abandon the mechanical drill method and start integrating the Concrete-Representational-Abstract (CRA) learning approach by utilizing local media in Bungo Regency to build conceptual understanding of place value and arithmetic operations; (2) Schools need to optimize diagnostic assessments to map learning deficits and design differentiated learning, as well as create a

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learning environment that is free from threats (psychological safety) to reduce students' mathematical anxiety; (3) For further researchers, it is recommended to develop and test arithmetic-based learning modules or local agrarian wisdom of Bungo Regency to increase the relevance and motivation of students to learn.

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