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Analysis of Mathematical Errors in The Discussion Process of Primary School Students

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Abstract *This study aims to identify the errors made by fifth-grade students at SDN Arjowinangun 1 during group discussions in mathematics learning. The research method used is qualitative descriptive, with data collection through observation and interviews. The results show that there are three main types of errors: conceptual errors, procedural errors, and communication errors. Conceptual errors are evident in the lack of understanding of basic concepts, while procedural errors arise from non-compliance with the correct steps in problem-solving. Communication errors involve the inability of group members to collaborate effectively. In addition, unhealthy group dynamics, such as dominance, lack of collaboration, and unclear roles, also contribute to the errors that occur. This study emphasizes the importance of a deep understanding of mathematical concepts, accuracy in procedures, and effective communication in the learning process. Suggestions are given to improve conceptual understanding, procedural skills, communication, and collaboration among students, as well as the need for further research on more effective teaching strategies.*

Keywords; *Mathematical errors; learning; group; communication; conceptual understanding.*

I. INTRODUCTION

Education plays a crucial role in educating the nation and shaping better individuals. Educational progress is synonymous with national progress, and can even transform a lagging country into a developed country maju (Andari, 2022). However, education is not just about mastering knowledge, but also developing balanced attitudes and skills. Mathematics, as a fundamental subject at all levels of education in Indonesia, hones numeracy skills and problem-solving accuracy (Zuliani & Puspita Rini, 2021). becomes an important foundation for further learning. The Independent Curriculum, with its flexibility, has the potential to improve the quality of mathematics learning, emphasizing conceptual understanding, skills, and problem solving (Mulyono, 2003) (Fathurohman, Apit) (Hadaming, Hamdana, 2022).

However, errors in mathematics learning, especially in the discussion process, are a common phenomenon in elementary schools. These difficulties can stem from internal factors, such as weak conceptual understanding or lack of skills, or external factors, such as uninteresting teaching methods, unsupportive learning environments, and negative student perceptions of mathematics (Arrosyad, Wahyuni, Kirana, & Sartika, 2023). The discussion process, although designed interactively and collaboratively, is not always effective in overcoming these difficulties.

Based on interviews with fifth-grade teachers at SDN Arjowinangun 1, only around 40% of students understand mathematics material well. Common errors include incorrect application of material, lack of conceptual understanding, and lack of study time at home. Although class discussions use grouping based on ability and peer correction, there are still 10% of students who lack focus and understanding of the material.

Previous studies (Ayu, Dwi Ardianti, & Wanabuliandari, 2021); by (Arrosyad M. , Wahyuni, Kirana, & Sartika, 2023); (Hadaming & Wahyudi, 2022) have examined the difficulties of learning mathematics in elementary schools, but this study focuses on the analysis of mathematical errors, especially in the discussion process. Therefore, this study entitled "Analysis of Mathematical Errors in the Discussion Process of Elementary School Students", aims to identify the types of errors that often occur and provide a more comprehensive picture of the challenges of learning mathematics in the classroom.

Learning is a transformative process that aims to acquire new knowledge and skills permanently (Syaiful, 1994). This process involves changes in the individual's cognitive, affective, and psychomotor. Education, as a learning medium, plays a vital role in the progress of a nation, shaping character, and preparing future generations. Various learning theories, such as Behaviorism, Cognitivism, and Constructivism, provide a framework for understanding how individuals learn and develop, helping educators design effective teaching methods.

In the context of mathematics learning, errors are a common phenomenon, in the form of deviations from the correct answer in solving mathematical problems. (Newman, 1977) (Murtiyasa & Wulandari, 2020). provides a framework for analyzing these errors, classifying them into four categories: reading, understanding, transformation, and execution errors. The discussion method, as an interactive learning approach, allows students to exchange ideas and collaborate. However, Newman's errors can also appear in discussions, seen at various stages, from understanding questions to expressing answers (Annisa & Kartini, 2021).

Furthermore, this theory is also relevant in analyzing errors in presentations and providing feedback. This study, entitled "Analysis of Mathematical Errors in the Discussion Process of Elementary School Students", aims to describe the analysis of mathematical errors in the discussion process of elementary school students. The results of the study are expected to be useful for students to improve their understanding and self-confidence, for teachers to improve the quality of learning, and for further researchers as a reference for further research.

II. METHOD

This study uses a descriptive qualitative approach to analyze mathematical errors in the discussion process of students at SDN Arjowinangun 1, Malang City. The researcher acted as a direct observer, recording errors and interactions during the discussion, and conducting structured interviews with students and teachers. Primary data were collected through direct observation of the discussion process and structured interviews, focusing on the types of errors that occurred based on Newman's theory. Data analysis was carried out descriptively qualitatively, including data reduction, data presentation, and drawing conclusions, with checking the validity of the data using triangulation of sources, techniques, and time. The research process includes preliminary stages (literature study, problem formulation, proposal and instrument preparation), data collection (observation, interviews), data analysis, and report preparation.

III. RESULTS

Data collection was conducted in two stages. The preparation stage included requesting a research permit to SDN Arjowinangun 1 on September 23, 2024, coordinating with grade 5 teachers to determine the observation schedule (September 30, 2024), and preparing research instruments (grids, observation sheets, interview guides, and written tests on the area of a flat surface). The implementation stage involved observing the discussion activities of 29 students in 3 groups on November 28, 2024, where students completed the area of a flat surface problem for 90 minutes. Observations focused on identifying errors based on Newman's stages, types of mathematical errors, and group dynamics. In-depth interviews were conducted with four selected students based on teacher suggestions, to explore their thinking processes and validate the observation results.

This study identified various mathematical errors made by grade V students of SDN Arjowinangun 1 during the group discussion process. The findings include three groups:

1. **Group 1**

   a. **Conceptual Errors**

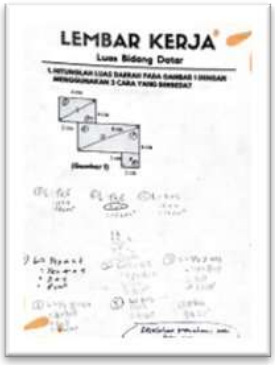

Figure 3.1 Results of Answers No. 1 Group 1

Analysis of the results of group 1's work shows a weakness in understanding the keywords of the question, which has an impact on incorrect solution steps. This indicates that the group made an error that resulted in an incorrect transfer of numbers to the formula, one of the factors being a lack of understanding of the keywords of the question can lead to incorrect interpretation, so that the solution steps taken are not in accordance with the intent and purpose of the question. As a result, the results of group 1's work did not reach the expected target.

   b. **Procedural Errors**

In procedural errors this group showed several weaknesses, including procedural errors that were apparent from the irregular sequence of steps, as well as a lack of accuracy in listing units and performing calculations (especially multiplication by ½). These errors resulted in incorrect final answers and underscore the importance of accuracy and deep conceptual understanding in mathematics.

Figure 3.2 Results of Answers No. 3 Group 1

   c. **Communication Errors**

The communication error that occurred in group 1 was caused by competence bias or ignoring opinions. This bias occurs when group members listen more to and value the opinions of members they consider more competent, while ignoring the opinions of other members. This can lead to unbalanced and less than optimal communication. Suggestions or opinions from members who are considered less competent are ignored, even though their opinions may have value and can provide a different perspective.

   d. **Behavioral Errors**

In group one, the researcher found that there were quite significant communication barriers. One of the students seemed passive and tended to be quiet even though he had been given assignments and opportunities to be involved in group discussions. The student still did not participate actively. Based on the results of the observation, the researcher suspected that the low appreciation of the student's opinions was the cause of his reluctance to communicate or interact

with other group members. After the discussion, the researcher conducted an interview with the student to dig deeper into his problems. The following is an excerpt from the interview with Azan.

Researcher: "Azan, is there anything confusing and not yet understood related to the broad material?"

Azan : "Yes, during the broad learning yesterday I was absent twice"

Researcher: "If Azan is absent or there are difficulties, what does Azan do, ask a friend or the teacher?"

Azan : "Study with Yunda"

Researcher: "Why doesn't Azan want to study together with other friends?"

Azan : "Embarrassed with other friends"

Researcher: "When Azan is with the teacher, does Azan dare to ask questions about the lessons that Azan doesn't understand?"

Azan : "No, because when he is with the teacher, he is told to fix it first and then he will tell you later"

2. Group 2

a. Conceptual Errors

In the results of conceptual error observations, several students experienced conceptual difficulties in recognizing and classifying geometric shapes and their formulas. Some were passive in the discussion because they did not understand how to recognize and classify geometric shapes and the difference between area and circumference. Therefore, the researcher confirmed this through interviews with these students. The following is an excerpt from the researcher's interview with Andin.

Researcher: "Andin, I noticed that you did not participate much in the discussion earlier. Is there something that is making you difficult?"

Andin : "It's okay, ma'am."

Researcher: "Okay. Can you explain the formula for calculating the area of a rectangle?

Andin : "Length x width, ma'am."

Researcher: "Good. You have mentioned the area formula, which is length x width. Now, try to explain what is meant by 'area' in the context of a rectangle. Imagine you want to paint a rectangular surface, what is measured by the area?"

Andin : "Mmm... I still don't really understand the difference, ma'am. But I know the formula."

Students in group 2 also still had difficulty identifying various triangle shapes. Some even misunderstood the keywords in the questions and misinterpreted the information. At the stage of working on the questions, many forgot to use the ½ formula in calculating the area, indicating errors in applying the algorithm and writing units.

Figure 3.3 Answer No. 1 Group 2 **Figure 3.4** Answer No. 3 Group 2

b. Procedural Errors

Group 2 experienced procedural errors because they did not follow the correct steps in solving the problem. They also forgot to include the units in the answer. This shows that group 2 was less careful and undisciplined in carrying out the problem-solving process. They may have been in a hurry or underestimated the steps and units. In fact, both are very important to ensure a correct and easy-to-understand answer. These procedural errors can have a negative impact on the final result and indicate a lack of understanding of the basic concepts in solving problems.

Figure 3.5 Answer No. 2 Group 2

c. Communication Errors

Communication in this group shows an imbalance of roles and a lack of collaboration. Some members only actively provide ideas without wanting to participate in the resolution process. They also tend to ask the teacher directly without trying to discuss and find solutions together in the group. This shows that this group lacks a sense of collective responsibility and lacks in building healthy discussion dynamics. They need to learn to support each other, discuss, and work together to complete tasks together. The inability to communicate and collaborate effectively can hinder the learning process and achieve optimal results in the group.

d. Behavioral Errors

This group experiences behavioral errors in the form of a lack of ability to listen carefully. They focus more on throwing ideas at each other and arguing, making it difficult to understand each other's perspectives. As a result, they have difficulty working together and solving problems effectively.

3. Group 3

a. Conceptual Errors

The results of group 3's work show a poor understanding of basic concepts. The inability to ignore the fundamental order of operations is very visible. Furthermore, errors in arithmetic operations were also found, indicating a lack of accuracy and precision in calculations.

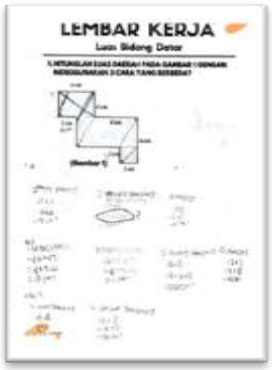

Figure 3.6 Answer No. 1 Group 3 **Figure 3.7** Answer No. 2 Group 3

b. Procedural Errors

This group shows procedural errors in the form of non-sequential and unsystematic solution steps. This hinders understanding of the flow of thought and results in errors in calculations or conclusions.

c. Communication Errors

This group has difficulty communicating effectively, especially in expressing mathematical ideas. There is a difference between what they think and what they convey, which causes misunderstandings and obstacles in the collaboration process.

d. Behavioral Errors

The lack of collaboration between group members results in very visible passive behavior. As a result, the task completion process becomes less effective and produces less than optimal work.

IV. DISCUSSION

Mathematical Errors in this study identified three main types of errors in understanding and using mathematics, namely conceptual errors, procedural errors, and communication errors.

Conceptual errors are a significant problem in mathematics learning, where students have difficulty understanding the basic concepts underlying the given problem. These errors are often seen from the wrong choice of formula or the inability to connect various relevant mathematical concepts. For example, in group 1, there was difficulty in understanding the keywords in the problem, which led to incorrect steps for solving. This conceptual error emphasizes the importance of a deep understanding of basic concepts before students proceed to the problem solving stage (Wahyuni, 2016). This finding is in line with research conducted by (Septihani, Chronika, Permaganti, Jumiati, & Fitriani, 2020), which shows that students who are unable to distinguish known information from the questions asked often face misunderstandings. Therefore, it is important for educators to focus on strengthening the understanding of basic concepts to help students avoid conceptual errors in the mathematics learning process.

Procedural Errors, students often make procedural errors in solving math problems, namely errors in the order of arithmetic operations or ignoring important steps. For example, group 2 forgot to include units or ignored the formula, which resulted in wrong answers (Sani & Suyanto, 2018). This finding is consistent with research (Dwi, 2020) which shows that lack of accuracy causes calculation errors and negligence in writing units. Therefore, it is important for students to always check their work to minimize errors.

Communication errors occur when ineffective communication in math discussions is characterized by students' difficulty in conveying their ideas clearly, both verbally and in writing. Communication imbalance, for example in group 1, occurs because the opinions of members who are considered less competent are ignored. This is in line with research (M Agil & Muhammad Irwan, 2024) which shows that differences in the level of involvement of group members can cause workload imbalance and frustration.

Newman's stage-based error model identifies four stages in solving math problems: reading, transformation, process, and expression. Each stage is prone to errors that can affect the final result.

In the Reading Stage, students must be able to understand the problem and identify relevant information. Understanding the problem and identifying important information are crucial steps in solving math problems. Mistakes at this stage, such as difficulty understanding the meaning of the problem or ignoring important information, for example, group 2 had difficulty distinguishing area and circumference, can lead to further errors. This finding supports research (Elvi, et al., 2024) which shows misconceptions about the area and circumference of flat shapes in elementary school students and suggests the use of interactive learning to overcome this problem.

The transformation stage in solving math problems involves processing information and applying the right formula or algorithm. Mistakes at this stage are often caused by the application of the wrong formula or algorithm, such as in group 2 who missed the factor ½ in the formula. This finding supports research (Andi, Irwan, & Rukli, 2023) which emphasizes the importance of reading story problems carefully to find the right information.

The Process Stage at this stage, the preparation of correct and structured answers, both verbally and in writing, is a characteristic of the process stage in problem solving. Mistakes at this stage can be in the form of unclear answers or errors in writing numbers or symbols. For example, group 1 showed errors in the sequence of solution steps, which resulted in the wrong final answer. This finding is in line with research (Nida Sri, Yenita, & Maimunah, 2022) which shows that procedural errors are often caused by incorrect selection and arrangement of solution steps. The expression stage requires students to present the final solution clearly and systematically. Difficulty in compiling or conveying answers, even though the solution has been found as in group 3, can lead to suboptimal results. Overcoming these difficulties may require a more practical and hands-on experience-based approach, as suggested by (Bettri, 2017) who emphasizes the importance of using teaching aids and direct experience to improve conceptual understanding, especially in spatial geometry material.

The influence of group dynamics is very large in the collaborative learning process. This study found that unhealthy group dynamics can worsen the results of discussions and solving math problems. Some factors that influence group dynamics include member dominance, lack of collaboration, and unclear roles.

Dominance in some groups, the dominance of one or two members who make unilateral decisions can inhibit the participation of other members and reduce valuable input as happened in group 1. This finding supports research (Erlyn, 2017) which shows that the discussion method is vulnerable to the dominance of several members.

Lack of collaboration was seen in several groups, where some students chose to work alone or just follow instructions without actively participating in the discussion, such as group 2 who immediately asked the teacher without discussing the group. This finding is in line with research (Dwi A., 2016) which shows the tendency of students to immediately ask the teacher or researcher without utilizing help from their group members.

Unclear roles in the group are also a factor that influences group dynamics. Some group members do not know how to contribute effectively, so they become passive in the discussion. In group 3, for example, some members seemed reluctant to participate actively, and ultimately the group was unable to solve the problem effectively. Overall, these errors in the group discussion process indicate that effective mathematics learning requires good collaboration, clear communication, and a deep understanding of mathematical concepts. Factors such as poor conceptual understanding, procedural errors, and unhealthy group dynamics can lead to repeated errors in solving math problems.

V. CONCLUSION

This study identified various errors made by fifth grade students of SDN Arjowinangun 1 during the group discussion process in mathematics learning. There were three main types of errors found: conceptual errors, procedural errors, and communication errors. Conceptual errors indicate a lack of understanding of basic concepts, procedural errors are seen from non-compliance with the correct solution steps, and communication errors include the inability of group members to collaborate effectively. This study also found that unhealthy group dynamics, such as dominance, lack of collaboration, and unclear roles, contributed to the errors that occurred. These findings emphasize the importance of a deep understanding of mathematical concepts, thoroughness in procedures, and effective communication in the learning process.

VI. SUGGESTION

To optimize mathematics learning in elementary schools, the implementation of integrated teaching strategies is crucial. This includes strengthening the understanding of basic concepts through interactive and contextual approaches, providing structured exercises to improve procedural skills and accuracy, and facilitating effective communication and collaboration through guided discussions and role assignments. Continuous monitoring of group dynamics and providing constructive feedback are also important to ensure the success of these strategies. Further research can focus on identifying contextual factors that influence the effectiveness of these strategies.

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