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Analysis of Errors in Solving Story Questions on Algebraic Operations Based Kastolan Theory Students SMP Negeri 6 Palu

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Abstract

This study examines students' errors in solving mathematical story problems, especially algebraic arithmetic operation story problems, based on Kastolan's theory and examines the factors that cause students to make these errors. The type of research used in this study is descriptive qualitative. The place of the research was SMP Negeri 6 Palu. The subjects in this study were grade VII students of SMP Negeri 6 Palu consisting of 1 student with several considerations obtained by low-ability students MH. Before being analyzed, the data obtained was validated first using member check. The data analysis techniques used in this study were data reduction, data presentation and drawing conclusions. The results of this study indicate that subject MH made 3 types of errors based on Kastolan's theory, namely: Conceptual Errors in the form of subjects being unable to apply formulas, classify variable forms in solving problems when using the formulas that have been obtained, subjects not writing down complete information known in the problem and errors in substituting known information into the problem. Procedural Errors in the form of irregularity in the solution steps used by the subject, there are several steps that are skipped so that the solution becomes wrong until the final stage of solving the problem. Technical Errors in the form of Subject MH making mistakes in calculating values in arithmetic operations are shown in the subject only dividing 2 each solution to get the results of the questions in the problem because the subject does not understand the formula to be used and is not right in substituting the values in the problem into the solution of the problem. The factors causing the errors made by students are divided into two, namely internal and external factors. Internal factors include low basic knowledge about the form of arithmetic operations, steps to solve problems in the form of stories and low knowledge of algebraic material. Lack of practice working on problems in the form of story problems and lack of student accuracy in solving story problems. External factors include students rushing when solving story problems because they want to finish them immediately and go to do other activities with their friends.

INTRODUCTION

Mathematics is an essential science for everyday life. Therefore, mathematics is a mandatory subject and needs to be studied by students at every level of education. This is in line

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with the opinion of Novtiar and Aripin [1], who stated that mathematics is one of the essential subjects at every level of education. This happens because mathematics is a human life activity, meaning every human activity uses mathematics. So, everyone needs to know primary material about mathematics to apply it and solve problems related to everyday life. Given the critical role of mathematics, understanding mathematics material from an early age needs to be improved in terms of mindset and its application.

The objectives of mathematics learning in the 2013 Curriculum are expected to enable students to 1) understand mathematical concepts, 2) use patterns as assumptions in solving problems, and be able to generalize problems based on everyday life or existing data; 3) use reasoning on properties, perform mathematical manipulations both in simplification and in solving problems in the context of mathematics and outside mathematics. Student learning is not only required to understand and master mathematical concepts but also to apply them to solve everyday life problems. The low understanding of students regarding basic mathematical concepts from various materials, one of which is story problems. Some students have difficulty solving story-based problems or problems directly implemented in everyday life compared to problems containing numbers [2]. As a result of the low understanding of mathematics learning, students often make various mistakes when working on problems, especially story problems.

Algebraic forms are abstract mathematical topics presented as story problems related to everyday life. This algebraic form material can also be used to solve problems related to everyday life. According to Fujirahayu [3], when students consciously and unconsciously pursue education, they find undesirable results when learning the concept of algebra related to everyday life. Therefore, students need to know the basic concepts first so that it is easy to solve the problems that occur.

In addition, many students often make mistakes when solving algebraic story problems. To convince researchers of the above problems, researchers conducted initial observations using identification tests conducted on class VII students of SMP Negeri 6 Palu, then obtained information proving that students still made many mistakes. From the results of the identification test, there were mistakes that students often made, namely mistakes in writing variables in examples in a story problem form and mistakes such as the inaccuracy of the steps used in solving the problem.

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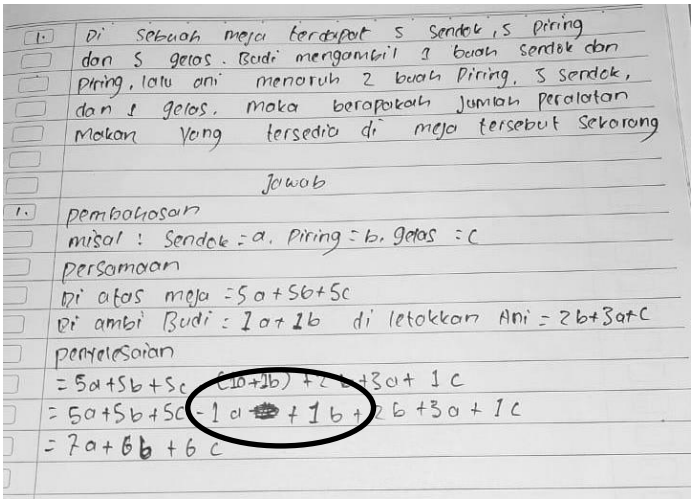

Figure 1Student A's Answer Results

In Figure 1, student A made a mistake in solving the story problem. Student A did not complete the work steps. There should still be one more step, namely solving the previous problem with verbal/everyday sentences, but student A did not write the step. The next mistake is the error in calculating the value of an arithmetic operation, seen in student A's solution in working; $-(1a + 1b)$ the student describes it as $-1a + 1b$ the negative sign should be multiplied by the value in the brackets, $-1a - 1b$ and the student also made a writing error which should be in the arithmetic operation $-(1a + 1b)$ of the variable $a$and b it does not need to be written again because the coefficient is 1.

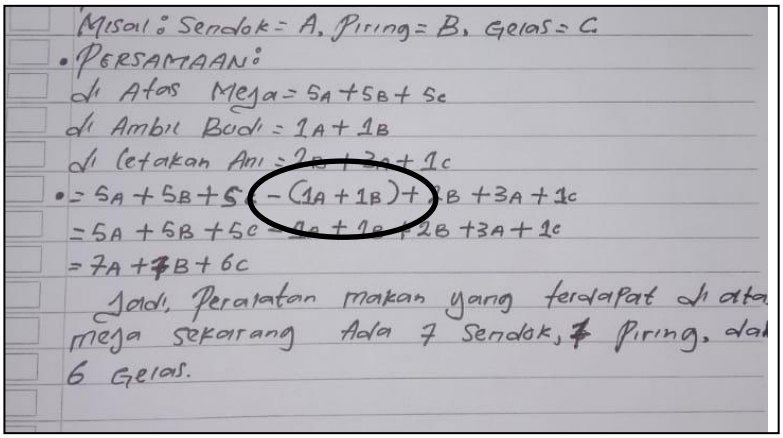

Figure 2. Student B's Answer Results

As seen in Figure 1.2 above, student B also made a mistake, namely a mistake in operating the brackets, the same mistake as student A, namely student B, who worked on $-(1a + 1b)$ explaining it as the negative sign multiplied by the value in the brackets $-1a - 1b$. The same mistake was made by student A, namely, the student also made a writing error, which should be

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in the $-1a+1b$ variable arithmetic operation a, and b does not need to be written again because the coefficient is 1.

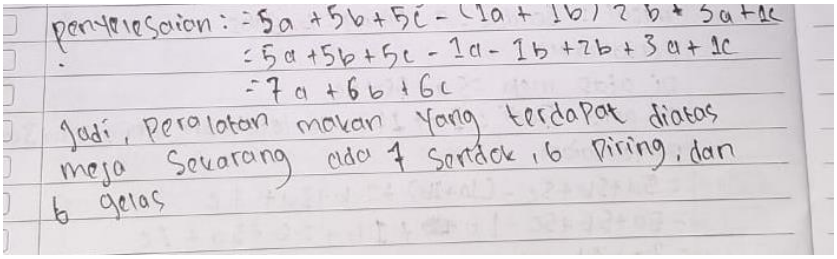

Figure 3. Student C's Answer Results

As seen in Figure 3, student C also made a mistake in solving the story problem that had been given; namely, student C did not change the algebraic form of the equation, and student C immediately performed the arithmetic operation without making an equation first. These steps should not be omitted because each step is related.

The mistakes made by students hurt their learning outcomes, so it is necessary to know the types of mistakes to be used as input for teachers in improving the learning process in the classroom. Febriansari [8] said that the factors causing difficulties in working on mathematics problems include students' confusion in determining mathematical models, lack of student accuracy, and a hasty attitude in solving problems.

One of the methods that can be used to identify errors made by students is using analysis based on Kastolan's theory. The Kastolan theory stage model views students' mathematical errors based on three things, namely conceptual errors, procedural errors, and technical errors [5]. Therefore, the author will identify student errors based on Kastolan's error analysis theory in this study.

METHODS

This research uses a qualitative approach. The type of research taken is descriptive qualitative research. The qualitative descriptive approach is a research procedure that produces data in words. This study aims to determine the types of errors and factors causing errors made by SMP Negeri 6 Palu students in solving story problems on algebraic arithmetic operations.

This research adopts a qualitative approach, explicitly utilizing descriptive qualitative methods. Descriptive qualitative research involves exploring and describing phenomena as they occur naturally to produce data in words rather than numerical values. This method allows a deeper understanding of students' thought processes, particularly in solving mathematical problems. By emphasizing detailed descriptions, the study seeks to capture the complexity of errors made by students when engaging with algebraic arithmetic operations in story problems.

The study focuses on students at SMP Negeri 6 Palu, aiming to analyze their performance in solving story problems related to algebraic arithmetic operations. Story problems are particularly significant in mathematics education because they require students to apply their understanding of mathematical concepts to real-world situations. These problems demand

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computational accuracy, conceptual solid understanding, and problem-solving skills. By examining how students approach and solve these problems, the study sheds light on specific challenges and identifies recurring error patterns.

The primary objective of the research is to categorize the types of errors students make and uncover the underlying factors contributing to these errors. These errors could range from misunderstanding the problem context to difficulties in mathematical reasoning or executing arithmetic operations accurately. The study also considers external and internal factors that may influence these errors, such as a lack of practice, insufficient grasp of foundational concepts, psychological pressures, or environmental distractions. The research aims to provide a comprehensive overview of the factors impacting students' success in solving story problems by analyzing these dimensions.

The findings of this study are expected to have practical implications for educators and curriculum developers. By understanding the nature and causes of student errors, teachers can implement more targeted instructional strategies to address specific weaknesses. For instance, incorporating more problem-solving exercises that simulate real-world scenarios can help students build their conceptual understanding and arithmetic fluency. Furthermore, fostering an encouraging and focused learning environment may help minimize external distractions contributing to errors. This study contributes to the growing body of research on mathematics education, aligning with prior works [1, 2], which emphasize the importance of error analysis and tailored instructional approaches in improving mathematical problem-solving skills.

RESULTS AND DISCUSSION

This research was conducted at SMP Negeri 6 Palu, located at Jl. Dewi Sartika No.71, South Birobuli, Palu City, Central Sulawesi. The time of this research was conducted on Thursday, January 15-19, 2024. Data collection was conducted face-to-face between the researcher and the research subject. The researcher grouped students based on their level of mathematical ability, referring to the odd semester mathematics exam scores, which aimed to determine the errors obtained in solving algebraic arithmetic operation story problems and the factors causing these errors. Furthermore, one student was selected from each level of mathematical ability obtained. The initials MS were selected as students with high mathematical ability, the initials DS were selected as students with moderate mathematical ability, and the initials MH were selected as students with low mathematical ability. A written test was then carried out based on the student categories grouped according to mathematical ability. After the test was carried out, one student was selected to be the subject of the research. A student with the initials MH (a low-ability student) was chosen to be the subject of this research. This selection was based on several considerations: students who made the most mistakes, suggestions from mathematics subject teachers, good communication skills, and the student's willingness to participate in a series of studies.

Based on the test results and interviews, students can make mistakes in solving algebraic arithmetic operation story problems. The results of the data analysis show the errors obtained based on Kastolan's theory, and the factors causing the errors are also obtained. Students do things. 1) Concept Error: subject MH made a mistake in solving the problem because he made a

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mistake in applying the formula and was wrong in expressing the concept/formula of the problem. The subject confidently said that he did not understand the meaning and the overall formula for substituting values into the solution form because the subject was still confused, so he was wrong in applying it. This error aligns with the fact that students are wrong in applying or applying the formula to the solution, so the answer is inappropriate. 2) Procedural Error: when solving the problem, the subject uses the steps taken incorrectly, does not provide an example of the mathematical form, the irregularity of the solution steps, and several steps are skipped so that the solution becomes wrong until the final stage, and the subject does not continue to the end of the steps in solving the story problem by not being able to conclude solving the problems in the problem using verbal/everyday sentences. These procedural errors made by low-ability students are in line with Firdaus [4]; namely, the form of procedural errors including Students do not complete the problem according to the steps requested, Students do not complete the problem to the final stage, or the most straightforward form, and Students are not sequential in processing the answers. 3) Technical Errors: subject MH made a mistake in calculating the value in the arithmetic operation shown in the subject only dividing 2 each solution to get the result of the question in the problem because the subject did not understand the formula to be used and was not right in substituting the value in the problem into the solution answer sheet. This error aligns with Lutfia & Zanthy [5]. Students are not careful when calculating arithmetic operations.

Mistakes made by students when solving math problems can be caused by various things. According to Amril [6], two factors cause students' mistakes in solving problems and can affect student learning outcomes: external and internal factors. Internal factors are health and psychological factors. At the same time, External factors come from outside the student. The factors that can affect learning outcomes are social, environmental factors, and non-social environmental factors. Internal factors include social and non-social environments.

Internal and external factors can influence errors made by students. Internal factors include health and psychological aspects. Health factors do not significantly contribute to errors when students are in good condition. However, psychological factors play a significant role. Students may lack an understanding of introductory algebra and arithmetic operations concepts, making it difficult to solve problems effectively. Additionally, insufficient practice with story problems leads students to rely on memorization rather than genuine comprehension. Other issues include a lack of precision and accuracy when solving problems, often stemming from low interest or talent in mathematics.

External factors are divided into social and non-social environmental influences. Social factors, such as the tendency to rush through problems to engage in social activities like visiting the canteen with friends, can lead to errors. In contrast, in this case, non-social environmental factors, such as the classroom setup or other physical conditions, were not found to have a significant impact on the students' mistakes. These internal and external factors highlight the need for academic and behavioral interventions to support students' learning processes.

Based on the factors causing errors obtained above, in line with Ayuningsih [7], the factors causing errors include difficulty in understanding the concept of the material given, lack of practice questions, hasty attitude in solving questions, lack of care in working, and lack of understanding of concepts in arithmetic operations.

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Two factors cause errors students make in solving algebraic arithmetic operation story problems: external and internal. Internal factors in the form of psychological factors, namely, in this case, factors that influence errors in solving problems, such as the subject's lack of understanding of the basic concepts of algebraic form material and lack of understanding of basic knowledge of arithmetic operations, lack of practice working on story problems so that students only memorize but do not understand and lack of student accuracy in solving story problems due to lack of interest and talent in mathematics subjects. External factors are social and environmental factors; several things influence students, such as rushing when solving story problems because they want to solve them immediately.

CONCLUSION

Based on the research analysis of the types of student errors in solving algebraic arithmetic operation story problems based on Kastolan's theory, it can be concluded that: (1) Conceptual errors, namely students are unable to express and apply formulas in solving story problems, and students are not suitable in classifying mathematical objects in the problem-solving. (2) Procedural errors, namely students are unable to solve story problems to the final stage, such as writing the conclusion of the solution obtained in the form of verbal/everyday sentences, and students are unable to rewrite the information known and asked in the story problem, as well as students' irregularity in solving story problems. (3) Technical errors, namely, students are still wrong in moving constants or variables to the next step, and students are still unable to perform arithmetic operations correctly, so students are wrong in determining their calculated values.

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