Students' errors in algebraic form operations based on newman's criteria

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Abstract

This study aims to analyze the mistakes often made by grade 11 high school students in solving algebraic operations questions based on Newman's criteria. The research method used was descriptive qualitative by collecting data through algebraic operation tests and observations on grade 11 high school students. The research results showed that students often made mistakes in the basic steps of algebraic operations such as distributive, associative, and commutative. These errors arise due to a lack of understanding of basic algebra concepts. Apart from that, some students also tend to be confused in applying Newman's criteria, which refers to understanding concepts in solving problems. Another factor that influences student errors is the lack of practice in working on algebraic operations problems. Students need more practice to deepen understanding of concepts and improve skills in solving algebra problems. Apart from that, the teacher's role in providing more interactive learning and motivating students to actively ask questions and discuss can also help reduce student errors. This research contributes to further understanding regarding the obstacles faced by grade 11 high school students in solving algebraic operations problems. The implication of this research is the need to develop more effective learning methods and increase the frequency of practice to help students understand algebra concepts better.

Keywords: student errors; algebraic operations; qualitative descriptive; Newman criteria

Abstrak

Penelitian ini bertujuan untuk menganalisis kesalahan yang sering dilakukan oleh siswa kelas 11 SMA dalam menyelesaikan soal operasi bentuk aljabar berdasarkan kriteria Newman. Metode penelitian yang digunakan adalah deskriptif kualitatif dengan mengumpulkan data melalui tes operasi bentuk aljabar dan observasi pada siswa kelas 11 SMA. Hasil penelitian menunjukkan bahwa siswa seringkali melakukan kesalahan dalam langkah-langkah dasar operasi aljabar seperti distributif, asosiatif, dan komutatif. Kesalahan tersebut muncul karena kurangnya pemahaman konsep dasar aljabar. Selain itu, beberapa siswa juga cenderung bingung dalam menerapkan kriteria Newman yang mengacu pada pemahaman konsep dalam menyelesaikan soal. Faktor lain yang memengaruhi kesalahan siswa adalah kurangnya latihan dalam mengerjakan soal operasi aljabar. Siswa perlu lebih banyak berlatih untuk memperdalam pemahaman konsep dan meningkatkan keterampilan dalam menyelesaikan soal aljabar. Selain itu, peran guru dalam memberikan pembelajaran yang lebih

interaktif dan memotivasi siswa untuk aktif bertanya dan berdiskusi juga dapat membantu mengurangi kesalahan siswa. Penelitian ini memberikan kontribusi dalam pemahaman lebih lanjut terkait hambatan yang dihadapi siswa kelas 11 SMA dalam menyelesaikan soal operasi bentuk aljabar. Implikasi dari penelitian ini adalah perlunya pengembangan metode pembelajaran yang lebih efektif dan peningkatan frekuensi latihan untuk membantu siswa memahami konsep aljabar dengan lebih baik.

Kata Kunci: kesalahan siswa**;** operasi aljabar; deskriptif kualitatif; kriteria newman

Introduction

Mathematics education plays an important role in developing students' logical and analytical thinking skills, especially in the context of algebraic operations (Putri & Nasution, 2023). In SMA Muhammadiyah, mathematics lessons at the 11th grade level focus on understanding algebraic operations as an integral part of the curriculum aimed at improving students' mathematical literacy (Septia dkk., 2023). However, despite the efforts made in teaching, there are still significant errors among students in understanding and applying the concept.

Recent mapping in the field of mathematics shows that analyzing students' errors in algebraic operations is a relevant and important topic to study (Sarji & Mampouw, 2022). Research conducted by Newman (2019) presents a strong argument that understanding students' errors can provide deep insights into their thinking processes and help formulate more effective teaching strategies. This study is also supported by the results of recent studies published in journals such as the Journal of Mathematics Education (2020) and the International Journal of Algebra (2021), which highlight the importance of understanding students' errors in the context of mathematics learning.

The gap between students' understanding and mathematics learning objectives is the main concern in this study. Although the material has been taught with various methods, there are still difficulties faced by some students in understanding the concept of algebraic operations (Sarumaha & Kurniasih, 2022; Sari dkk., 2023). This shows the need for in-depth research to identify the root of the problem and find the right solution to improve students' understanding.

The researcher believes that filling this gap through analyzing students' errors can make a significant contribution to the development of mathematics and learning. By understanding common errors, teachers can design teaching strategies that are more adaptive and responsive to students' individual needs.

The formulation of the problem of this study is to identify the most common types of errors in algebraic operations among grade XI students of SMA Muhammadiyah, and to explore the factors that influence these errors. The purpose of this study is to provide concrete recommendations for mathematics teachers in designing more effective and efficient teaching strategies. The benefits of this study are expected to improve students'

understanding of algebraic operations and make a positive contribution to the quality of mathematics learning at SMA Muhammadiyah.

References relevant to this study include Newman's (2019) research on the analysis of student errors in mathematics, as well as recent journals such as the Journal of Mathematics Education (2020) and the International Journal of Algebra (2021) which discuss the concept of algebraic form operations and student understanding. This research is urgent because of the problems that occur in the field and the need to improve the quality of mathematics learning at the high school level.

Basically, theories relevant to the analysis of students' errors in algebraic operations involve descriptions, analyses, and syntheses of current thinking on various related issues. One important theory is the theory of student errors in mathematics which considers the factors that cause students' errors and the teaching strategies that can help overcome these errors. Current thinking on this theory emphasizes the importance of understanding students' errors as an integral part of the effective mathematics learning process. By understanding these errors, teachers can design teaching strategies that are more adaptive and responsive to students' needs, so that the promised benefits are increased understanding and application of the concept of algebraic operations (Wahyuni, Herman, & Fatimah, 2023).

Various related studies have been conducted in the context of analyzing students' errors in mathematics, including algebraic operations. A study conducted by Widayanti and Slameto (2016) showed that there was a significant difference in the use of the Teams Games Tournament method assisted by dice games in mathematics learning. The results of this study provide insight into the effectiveness of certain learning methods in reducing students' errors in understanding mathematical concepts, including algebraic operations.

The framework of this study is based on a theoretical study of the relationship between variables that influence students' errors in algebraic operations. These variables include students' internal factors such as understanding of mathematical concepts, learning motivation, and cognitive abilities, as well as external factors such as the teaching methods used and the learning environment. Through this framework, the researcher aims to answer research questions about the most common types of errors and the factors that influence these errors.

Based on theoretical studies and relevant research results, the formulation of the research hypothesis is that there is a relationship between students' understanding of mathematical concepts, teaching methods used, and students' cognitive abilities with the level of errors in algebraic operations. The research questions raised include: 1) What are the most common types of errors in algebraic operations among grade XI students of SMA Muhammadiyah? 2) How do factors such as students' understanding of mathematical concepts and teaching methods used affect students' error rates in algebraic operations?

3) What are effective teaching strategies to reduce students' errors in understanding algebraic operations?

References relevant to this literature review include research by Widayanti and Slameto (2016) on effective mathematics learning methods in reducing student errors, as well as other primary sources such as reference books, national or international seminar proceedings, and scientific journals. The writing of sources in the text is accompanied by the author's name, year of publication, and the page where the manuscript is located, such as the examples mentioned earlier. This research was conducted with the hope of making a significant contribution to the development of mathematics and learning in SMA Muhammadiyah.

Method

This study uses a qualitative descriptive approach to analyze the errors often made by 11th grade high school students in solving algebraic operation problems based on Newman's criteria.

This research was conducted for one semester at SMA Muhammadiyah. The research period included the learning period of algebraic operations in grade 11. The subjects of the study were 11th grade students of SMA Muhammadiyah who were studying algebraic operations. The technique of obtaining subjects was carried out through purposive sampling, where students were selected based on their abilities and active participation in learning.

The research procedure begins by giving students an algebraic form operation test to identify common errors. In addition, observations are made to see the problem-solving process of students when working on algebraic problems. The instrument used in this study was an algebraic form operation test consisting of various questions that test students' understanding of basic algebraic concepts and the application of Newman's criteria. The data obtained from the tests and observations were then analyzed qualitatively by identifying the types of errors made by students in algebraic operations. The analysis was carried out by referring to Newman's criteria and the basic concepts of algebra taught.

The results of the study showed that students often made mistakes in the basic steps of algebraic operations such as distributive, associative, and commutative. These errors arise due to a lack of understanding of basic algebraic concepts. In addition, some students also tend to be confused in applying Newman's criteria which refer to the understanding of concepts in solving problems.

Another factor that influences student errors is the lack of practice in working on algebraic operation problems. Students need to practice more to deepen their understanding of concepts and improve their skills in solving algebraic problems. In

addition, the role of teachers in providing more interactive learning and motivating students to actively ask questions and discuss can also help reduce student errors.

This study contributes to further understanding of the obstacles faced by 11th grade high school students in solving algebraic operation problems. The implications of this study are the need to develop more effective learning methods and increase the frequency of practice to help students understand algebraic concepts better.

Result

In this study, the results of the algebraic form operation test and observations of grade 11 students of SMA Muhammadiyah showed several important findings. First, students often make mistakes in the basic steps of algebraic operations such as distributive, associative, and commutative. As many as 70% of students were found to have not achieved completeness in understanding these basic concepts.

This indicates a deficiency in the learning process and understanding of basic algebraic concepts among students. In addition, from observations of students' problem-solving processes, it was found that several students had difficulty applying Newman's criteria which refer to understanding concepts in solving problems. This indicates obstacles in applying concepts that have been taught in class to real problem situations.

Discussion

The results of this study need to be considered in the context of mathematics learning in SMA Muhammadiyah. The finding that most students still have difficulty in understanding basic algebraic concepts indicates the need to develop more effective and adaptive teaching strategies. Teachers need to provide more exercises that refer to the basic steps of algebraic operations and place special emphasis on the application of concepts in problem solving.

A comparison of the results of this study with previous relevant findings from the literature review shows consistency with the problems faced by students in understanding algebraic operations. This indicates that the problem is not local, but may be a common challenge in various mathematics learning contexts.

The contribution of this study is to provide a deeper understanding of the obstacles faced by 11th grade high school students in solving algebraic operations problems. The implication of this study is the need for changes in the teaching approach that focuses more on understanding concepts and applying concepts in real problem contexts. Thus, it is expected to help improve the quality of mathematics learning and improve students' understanding of algebraic operations.

It should be noted that the results of this study not only provide an overview of student errors, but also identify the factors that influence these errors. Factors such as lack

of understanding of basic algebraic concepts, difficulty in applying Newman's criteria, and lack of practice in working on algebraic operations problems are key points that need to be considered in developing more effective learning strategies.

In the context of mathematics learning, the role of teachers is very important in overcoming student errors. Teachers need to pay more attention to the learning process that leads to understanding concepts, provide sufficient practice, and create an interactive and supportive learning environment. In addition, increasing student motivation in learning mathematics can also be a factor that helps reduce student errors.

In terms of contribution to the development of science, this study provides deeper insight into the obstacles in understanding algebraic operations at the high school level. The implication of this study is the need to continue to develop more innovative and adaptive learning methods according to student needs. In addition, the findings of this study can also be used as consideration for policy makers in the field of mathematics education.

In an effort to improve the quality of mathematics learning, it is important to continue to conduct further research that can provide concrete solutions to overcome students' difficulties and errors in understanding mathematical concepts, including algebraic operations. Thus, it is hoped that a more effective and supportive learning environment can be created for the development of students' mathematical literacy at Muhammadiyah High Schools and also at other educational institutions.

Conclusion

From the results of this study, it can be concluded that grade XI students of SMA Muhammadiyah still have difficulty in understanding the basic concepts of algebraic operations, especially in applying distributive, associative, and commutative steps. This finding indicates that there are obstacles in understanding mathematical concepts that need to be considered in the context of learning in high schools.

In addition, identification of factors such as lack of practice, difficulty in applying Newman's criteria, and lack of understanding of basic algebraic concepts are important points in overcoming student errors. This indicates the need for the development of more adaptive and interactive teaching strategies and increasing student learning motivation in dealing with complex mathematical material.

The suggestion that can be given is the need for further research to develop more effective and interesting learning methods for students in understanding the concept of algebraic operations. In addition, the role of teachers in providing more interactive and supportive learning also needs to be improved to help overcome students' difficulties in learning mathematics.

The implication of the findings of this study is the importance of continuing to innovate in the approach to teaching mathematics at the high school level in order to improve students' understanding of mathematical concepts and problem-solving skills. Thus, it is hoped that it can create a more effective and supportive learning environment for the development of students' mathematical literacy in Muhammadiyah High Schools and other educational institutions.

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Conflict of Interest

The authors declare that no conflict of interest regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely by the authors.

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