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Analysis of Students' Difficulties in Completing Operational Problems with Algebraic Forms

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Abstrak

Tujuan penelitian ini adalah untuk menganalisis kesulitan siswa SMP dalam menyelesaikan soal operasi hitung yang ditinjau dari penguasaan tiga elemen dalam pembelajaran matematika yaitu konsep, keterampilan dan pemecahan masalah serta mengetahui faktor penyebab kesulitan yang dialami siswa. Jenis penelitian yang digunakan yaitu penelitian kualitatif dengan menggunakan metode deskriptif. Subjek dalam penelitian ini adalah siswa kelas VII-A SMP Negeri 1 Manganitu dengan jumlah siswa sebanyak 21 orang. Instrumen yang digunakan dalam penelitian ini adalah 5 butir soal essay operasi hitung bentuk aljabar. Hasil penelitian ini menunjukkan bahwa siswa mengalami kesulitan dalam menyelesaikan soal operasi hitung bentuk aljabar dengan persentase memahami konsep 45,71% tergolong kategori cukup tinggi, persentase dalam hal keterampilan 22,38% tergolong kategori rendah dan persentase melakukan pemecahan masalah 13,33% tergolong kategori sangat rendah.

Kata kunci: Kesulitan Siswa, Konsep, Keterampilan, Pemecahan Masalah.

Abstract

The purpose of this study was to analyze the difficulties of junior high school students in solving arithmetic operations questions in terms of their mastery of the three elements of learning mathematics, namely concepts, skills, and problem-solving, as well as knowing the factors that cause difficulties experienced by students. The type of research used is qualitative research using descriptive methods. The subjects in this study were class VII-A students of SMP Negeri 1 Manganitu, totaling 21 students. The instrument used in this study was five items essay on arithmetic operations in algebraic form. The results of this study indicate that students experience difficulties in solving algebraic arithmetic operations questions, with a percentage of understanding the concept 45.71% belonging to the fairly high category, a percentage in terms of skills 22.38% belonging to the low category, and a percentage doing problem-solving 13.33% belonging to the category very low.

Keywords: Student Difficulties, Concepts, Skills, Problem Solving.

INTRODUCTION

Mathematics is a science that cannot be separated from human life. Mathematics helps humans meet their daily needs, for example, in operating calculations such as addition, subtraction, multiplication, and division (Pinahayu, 2016; Domu & Mangelep, 2019). Mathematics is also crucial in school because it can form students' logical, critical, and systematic mindsets (Surat, 2016; Domu & Mangelep, 2020). The goals of learning mathematics stated in the 2013 curriculum are that students must be independent in obtaining information and learning to link ideas between concepts, be skilled at using mathematical concepts, and continue to solve problems (Septiyana & Pujiastuti, 2018; Nurikawai et al., 2021).

In achieving the goals of learning mathematics, many obstacles still hinder these goals. One of the obstacles is that students still need help to solve math problems (Hikmah et al., 2019; Domu & Pesik, 2020). A student can be said to have learning difficulties if the student shows a failure to achieve learning goals (Kallesta & Erfan, 2017; Pausina, 2018).

The difficulty in learning mathematics experienced by students means that difficulties in understanding the parts of mathematics can be only one part, or it can also be more than one part of mathematics (Hasan, 2015). When viewed from the diversity of mathematical material, where one mathematical discussion is related to another, this can impact the difficulties of one or more other topics (Sugiarti, 2018). This means that students' difficulties in learning one part of mathematics affect students' difficulties in learning other parts of mathematics (Nurhikmayati, 2017; Sugiarti, 2018). Mathematics learning difficulties experienced by students can also be caused by factors from within the student and factors from outside the student. Factors from within students, for example, health, talent, interest, and intelligence (Mukminah et al., 2021). Meanwhile, factors from outside the student's self-include the school environment, family, and community (Nabillah & Abadi, 2020).

Algebraic arithmetic operations are material that students learn at the junior high school level. In learning algebraic arithmetic operations, students learn the arithmetic operations of addition, subtraction, multiplication, and division (Sari & Afriansyah, 2020; Lestari & Suryadi, 2020). Algebraic arithmetic operations benefit students, especially for studying mathematics material at a higher education level (Zulaika & Febrilia, 2019). In this way, students must master the material of algebraic arithmetic operations well to be able to study mathematics material at the next level.

According to information from the math teacher at SMP Negeri 1 Manganitu, many Grade VII students still need to improve in solving algebraic arithmetic operations. The mistakes made by these students are evidence that class VII students of SMP Negeri 1 Manganitu have difficulty solving questions on arithmetic operations in algebraic forms.

Research on the analysis of learning difficulties in mathematics in solving algebraic operations questions was carried out by Herawati and Kadarisma (2021). Their research resulted in identifying the difficulties experienced by seventh-grade students of junior high school when solving arithmetic operations questions related to mastery of concepts, namely (1) identifying the characteristics of a concept and knowing the conditions for determining a concept with a percentage of 50.8% in the low category; (2) comparing and contrasting concepts has a percentage of 52.72% in the low category; (3) using models, diagrams and symbols to represent a concept has a percentage of 30.4% in the deficient category; (4) knowing the various meanings and interpretations of concepts has a percentage of 18.3% in the deficient category. Meanwhile, Lerner (Magdalena et al., 2020) suggests that learning difficulties in mathematics can be seen from mastery of the three elements of learning mathematics: concepts, skills, and problem-solving.

In this article, we will discuss the difficulties experienced by class VII students of SMP Negeri 1 Manganitu in solving arithmetic operations in algebraic forms, which can be seen from their mastery of the three learning elements.

METHOD

This qualitative research uses a descriptive method to analyze the difficulties experienced by grade VII junior high school students in solving algebraic arithmetic operations. This research was conducted in class VII of SMP Negeri 1 Manganitu in the odd semester of the 2022/2023 academic year. The subjects of this study were randomly selected, namely class VII-A students, with a total of 21 students. The instrument used in this study was the researcher himself as the main instrument and supporting instruments in the form of tests validated by three validators and other supporting instruments in the form of interviews. Data analysis techniques in this study were carried out in three stages: data reduction, data presentation, and drawing conclusions.

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RESULT AND DISCUSSION

From the results of the algebraic arithmetic operations test performed by students, it was found that many students made mistakes in solving the problem. The following is a table of errors made by class VII students of SMP Negeri 1 Manganitu when working on arithmetic operations on algebraic forms.

Table 1. Percentage of the number of errors experienced by students

Student Code	Items										Student Presentation of Error (%)
	1			2		3		4		5	
	a	b	c	a	b	a	b	a	b		
S01	K	K	K	P	S	K	S	K		S	90%
S02	K	K	K	K	K	K	S	K	S	K	100%
S03				K	K	K	P	K	S	S	70%
S04				S		S		P	S	S	50%
S05				K	P	S		K	S	K	60%
S06				P	P	P		K	S	P	60%
S07				K	K	S		P		K	50%
S08	K	K	K	K	P	K		P	P	P	90%
S09	K	K	K	S	S	S	S	K	S	S	100%
S10				S	S	S	S	P	S	S	70%
S11				S	S	K	K	K		S	60%
S12	K	K	K	K	K	P	P	P	P	P	100%
S13	K	K	K	K	P	K	P	K	P	K	100%
S14	K	K	K	K	K	K	K	K	S	K	100%
S15				K	K	K		K	S	P	60%
S16	K	K	K	S	S	S		K	S	S	90%
S17	K	K	K	K	K	K	K	P	K	K	100%
S18	K	K	K	S	S	S		K		K	80%
S19	K	K	K	K	K	K	K	P	K	K	100%
S20	K	K	K	S		P	P	P	S	S	90%
S21	K	K	K	S	S	K	S	P	S	K	100%
Overall Percentage											81.90%

Information:
K: Concept
S: Skills
Q: Troubleshooting

Based on table 1 above, eight students have the highest percentage of errors, namely 100%. Furthermore, two students have a minor percentage of errors, namely 50%, compared to other students. Based on table 1, it was also found that 81.90% of students made mistakes in solving the algebraic arithmetic operations test questions.

The data in table 1 is then summarized based on the types of difficulties experienced by students. The following table shows the percentage data for the types of difficulties students experience.

Table 2. Percentage of Difficulty Understanding the Concept

	Items		Many Students	Percentage of Overall Question (%)
Concept Question	1	a	13	61.90%
		b	13	
		c	13	
	2	a	11	45.24%
		b	8	
	3	a	11	35.71%
		b	4	
	4	a	12	33.33%
		b	2	
	5		9	42.86%
Overall percentage				45.71%

Table 3. Percentage of Skill Difficulty

	Skills		Many Students	Percentage of Overall Questions (%)
Items	**1**	a	0	0%
		b	0	
		c	0	
	2	a	9	38.10%
		b	7	
	3	a	7	28.57%
		b	5	
	4	a	0	26.19%
		b	11	
	5		8	38.10%
Overall Percentage				**22.38%**

Based on table 2 to table 3, it was found that 45.71% of students had difficulty understanding concepts, 22.38% of students had difficulty in skills, and 13.33% of students had difficulty solving problems and solving operational questions in algebraic forms.

Table 4. Percentage of Problem-Solving Difficulties

	Problem-Solving		Many Students	Percentage of Overall Questions (%)
Items	**1**	a	0	0%
		b	0	
		c	0	
	2	a	1	11.90%
		b	4	

	3	a	3	16.67%
		b	4	
	4	a	9	28.57%
		b	3	
	5		4	19.05%
Overall Percentage				13.33%

Table 5. Categories of Student Difficulties

No.	Numbers	Category
1	81% - 100%	Very High
2	61% - 80%	High
3	41% - 60%	Fairly High
4	21% - 40%	Low
5	0% - 20%	Very Low

After obtaining the results of the tests and analysis, interviews were conducted with 5 class VII students of SMP Negeri 1 Manganitu. The following are the results of tests and interviews of students who experience difficulties.

1. Subject in question number 1 (S12)

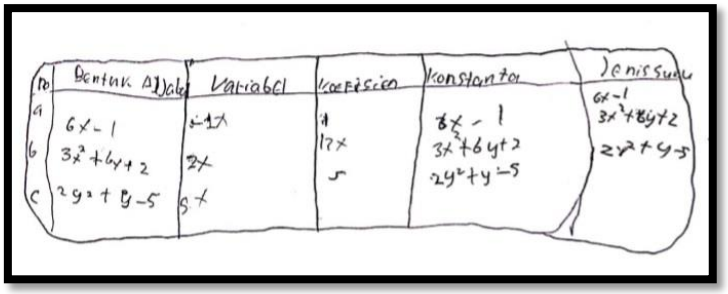

Figure 1. Answer no. 1 S12

From the results of the interviews, it was found that S12 students had difficulty conceptualizing. Students need to understand the process of solving the correct problem. Students solve problem number 1 using the multiplication operation, while in question number 1, there is no need to do multiplication. Students are only asked to determine variables, coefficients, constants, and types of terms. Students also do not know what is meant by variables, coefficients, constants, and types of tribes, so students cannot answer question number 1 correctly.

2. Subject in question number 2 (S02)

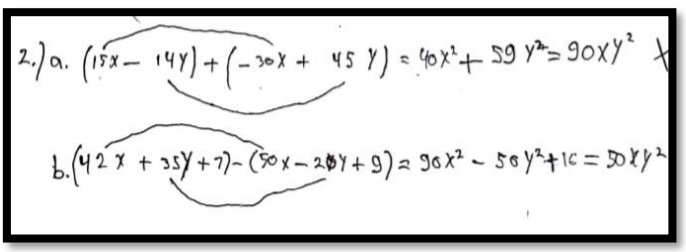

Figure 2. Answer no. 2 S02

The results of interviews with S02 students found that in question number 2, the students needed to understand the process of solving the correct problem. Students need help with calculating the addition and subtraction of algebraic forms. Then in question number 2a, students add up all elements even though they have different variables as well as question number 2b, students subtract all existing elements even though they have different variables, while the process of algebraic addition and subtraction operations is by adding or subtracting elements that have the same variable. In addition, in questions 2a and 2b, students use the multiplication operation only on the same variables.

3. Subject in question number 3 (S21)

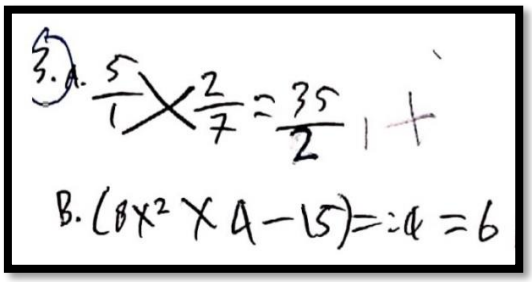

Figure 3. Answer no. 3 (S21)

The results of interviews with S21 students found that students needed to be corrected in operating the multiplication and division concepts in question number 3. The student explained that in question 3a, he solved the problem using the cross-multiplication method, while to solve problem 3a, students did not need to use the cross-multiplication method. Students only need to multiply all.

The components in question no. 3a, such as coefficients, variables, and constants. In question 3b, the student explained that he solved the problem by multiplication in layers, while in solving problem 3b, students only needed to use the method of division in layers.

4. Subject in question number 4 (S14)

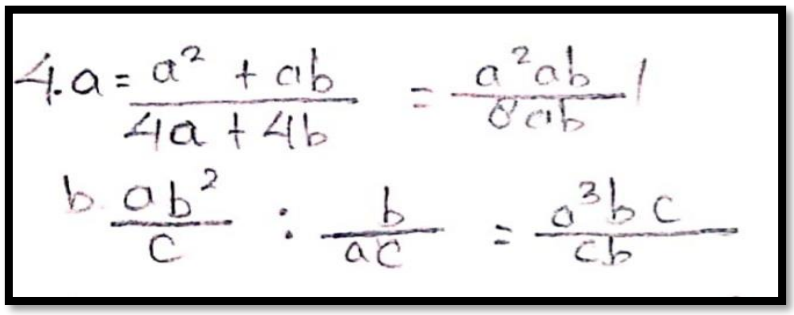

Figure 4. Answer no. 4 (S14)

From the interview results above, it was found that S14 students needed to be corrected in simplifying algebraic forms. For question 4a, the student explained that he simplified the algebraic form by adding up all the elements in the quantifier and also adding up all the elements in the denominator, whereas to solve problem 4a, where an algebraic form is a fractional form, students must understand the concept of factors to be able to divide the quantifier and the denominator if there are common factors. For question 4b, the student explained that he solved the problem by crossing it. The student already understood how to solve the problem. However, the student still needed to be corrected in determining the multiplication result. This shows that in question 4b, students already understand the concept of solving the problem but still need help in arithmetic operations (skills).

5. Subject in question number 5 (S19)

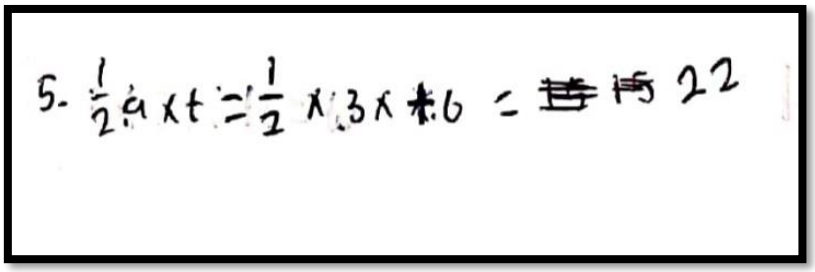

Figure 5. Answer no. 5 (S19)

Based on the interview results, it was found that the S19 students understood what was asked in question number 5 but needed to be corrected in determining the formula to be used. Students use the formula for the area of a triangle to calculate the perimeter of a triangle. In addition, students believe that the formula for finding the perimeter of a triangle is $\frac{1}{2} \times a \times t$.

In addition, an interview was also conducted with the mathematics teacher at SMP Negeri 1 Manganitu to find out the learning model and the obstacles he experienced when teaching mathematics. From the results of interviews with the mathematics teacher at SMP Negeri 1 Manganitu, it can be obtained that the mathematics teacher at SMP Negeri 1 Manganitu in his learning uses the 21st-century learning model known as 4C, namely Critical Thinking, Collaboration, Communication, and Creativity. However, when students still encounter obstacles. The obstacle found when teaching is that some students have physical weaknesses in the eyes and hands, which make these students slow to understand learning in class, so the teacher must find free time, such as breaks, to explain the material back to these students.

From the data analysis and interview results above, it was found that difficulty understanding concepts was an indicator of the most difficulty experienced by class VII students of SMP Negeri 1 Manganitu in solving arithmetic operations in algebraic forms compared to the other two indicators. The difficulty experienced by students in understanding the concept is the difficulty in determining the initial idea in solving the problem so that in solving the problem, students get the result that is wrong or wrong. Difficulty understanding the concept also occurs because students need help understanding the properties or conditions of applying a formula.

CONCLUSION

Based on the results of the research and analysis of the data obtained, it can be concluded that the difficulties experienced by class VII A students of SMP Negeri 1 Manganitu in solving questions of arithmetic operations in algebraic forms in terms of mastery of the three elements of learning mathematics, namely: (1) difficulty understand the concept with a percentage of 45.71% belonging to the fairly high category. (2) The difficulty in student skills, with a percentage of 22.38%, is in a low category. (3) The difficulty of solving problems is 13.33% belonging to the very low category.

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