



# Examining Mathematical Misconceptions Among Seventh-Grade Students in Fraction Operations

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## Abstract

This study aims to identify the types of misconceptions experienced by seventh-grade junior high school students when solving fraction operation problems. A descriptive qualitative approach was employed, involving five students selected through purposive sampling as the research participants. Data were collected through essay tests and classroom observations. The findings revealed three major types of misconceptions: **generalization misconceptions**, in which students applied whole-number procedures to fraction operations; **calculation misconceptions**, involving procedural and computational errors in performing fraction operations; and **notation misconceptions**, characterized by incomplete responses that omitted appropriate units, mathematical symbols, or concluding statements. Low-performing students exhibited a greater variety of misconceptions than high-performing students. Although some students performed the calculations correctly, they still demonstrated misconceptions in presenting their solutions completely and contextually. These findings highlight the importance of teachers' understanding of students' reasoning processes in order to accurately identify and effectively address mathematical misconceptions.

**Keywords:** calculation misconceptions; fraction operations; generalization misconceptions; mathematical misconceptions; notation misconceptions

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## Introduction

Mathematics is one of the fundamental disciplines introduced to students from the elementary school level. Despite being taught from an early age, mathematics remains a challenging Student for many students (Suciati, 2021). It is often perceived as one of the least preferred school Students because its concepts are considered difficult to understand and retain. As a result, many students become disengaged from mathematics learning, particularly when



they struggle to comprehend the material (Rahmawati et al., 2024). Similarly, Kurniawati and Ekayanti (2020) argued that mathematics instruction differs from other disciplines due to its distinctive methodology and relatively high level of conceptual complexity.

As a universally applicable discipline, mathematics plays a significant role in technological advancement, contributes to the development of various scientific fields, and fosters logical reasoning skills (Fidayanti et al., 2020; Luritawaty et al., 2026). In response to rapid technological development, the education sector is required to continuously adapt by integrating information and communication technologies into mathematics teaching and learning to improve educational quality (Jayantika & Namur, 2022). Consequently, efforts to advance technology must be accompanied by continuous improvements in the quality of mathematics education (Simanjuntak et al., 2021; Rahayu et al., 2023).

According to the objectives of mathematics education outlined in the Indonesian Ministry of National Education Regulation No. 22 of 2006, students are expected to develop conceptual understanding, recognize relationships among mathematical concepts, and apply mathematical concepts or algorithms accurately, efficiently, and flexibly in solving problems (Nurkamilah, 2021; Hidayat, 2024). These objectives highlight the importance of conceptual understanding in mathematics learning. Mathematical concepts are organized systematically, hierarchically, and logically, enabling students to build more complex knowledge upon previously acquired fundamental concepts (Fridatama et al., 2021; Hidayat & Nuraeni, 2022). Therefore, mathematics instruction should not merely emphasize the transmission of knowledge but should also promote students' mathematical competence, critical thinking, and problem-solving skills (Dwi et al., 2023).

Fractions constitute one of the fundamental topics introduced in mathematics from the early stages of education (Saputri, 2021; Afriansyah & Turmudi, 2022). Although fractions are included in the basic mathematics curriculum, students frequently experience difficulties in understanding fraction concepts, particularly at the junior high school level (Anggraeni et al., 2020). Fraction concepts are widely recognized as among the most challenging topics in mathematics learning. These difficulties often arise because students tend to treat fractions merely as mathematical symbols to be manipulated procedurally without understanding their underlying conceptual meaning (Nur'Ariyani, 2023). A sound understanding of fractions is essential because the concept serves as a foundation for learning mathematics at secondary and higher education levels (Ulfa et al., 2021).

These learning difficulties may lead to misconceptions, namely incorrect understandings that students mistakenly believe to be correct. Misconceptions frequently occur in fraction operations and therefore require careful identification and remediation (Sadiah & Afriansyah, 2023). Students who fail to develop accurate conceptual understanding may encounter persistent learning difficulties that negatively affect their future mathematical achievement (Nur'Ariyani, 2023). Furthermore, Atiqoh and M. (2021) argued that misconceptions interfere with the acquisition of new mathematical concepts and adversely affect students' problem-

solving performance. Consequently, eliminating misconceptions should become a major concern for both teachers and students (Aldianisa et al., 2021).

Nevertheless, students' misconceptions in mathematics cannot simply be attributed to the perception that mathematics is inherently difficult (Muchyidin et al., 2020; Rahma & Afriansyah, 2024). Teachers themselves construct mathematical understanding based on their own experiences, which may not always align with scientifically accepted mathematical concepts. Moreover, several mathematical concepts are inherently abstract, counterintuitive, and conceptually demanding, making them difficult to teach and learn effectively. Consequently, teachers may also develop misconceptions regarding the content they teach. This highlights the importance of restructuring teachers' conceptual understanding as an essential step toward reducing misconceptions in mathematics instruction (Arifiati et al., 2023).

Misconception analysis seeks to identify and explain students' conceptual misunderstandings in order to determine the nature and sources of those misconceptions (Sadiah & Afriansyah, 2023). Although misconceptions have become an important research topic in mathematics education, their complexity continues to hinder efforts to improve students' mathematical understanding. Recent studies have provided valuable insights into the various types of misconceptions, their effects on students' mathematical learning, and effective approaches for identifying and addressing them. In particular, recent literature reviews have synthesized findings concerning common mathematical misconceptions and their underlying causes (Putri, 2024).

Teachers' understanding of students' misconceptions enables them to develop more effective instructional strategies that promote accurate conceptual understanding (Nasution et al., 2021). Sadiah and Afriansyah (2023) emphasized that identifying misconceptions in fraction operations allows teachers to assist students in correcting conceptual errors while addressing the learning difficulties they experience. More importantly, teachers can determine precisely where misconceptions occur and subsequently implement appropriate instructional interventions. It is also important to note that misconceptions are not limited to low-achieving students; they may also be found among students with moderate and high levels of academic achievement.

Based on the classification proposed by Sadiah and Afriansyah (2023), this study adopts three categories of misconceptions in fraction operations: **generalization misconceptions**, **calculation misconceptions**, and **notation misconceptions**. The indicators associated with each category are presented in **Table 1**.

**Table 1.** Types and Indicators of Student Misconceptions

<b>Types of Misconceptions</b>	<b>Indicators</b>
Generalization Misconception	Misconceptions in equalizing denominators Misconceptions in understanding mixed fractions Misconceptions in understanding fraction operations
Calculation Misconceptions	Misconceptions in performing fraction calculations

Types of Misconceptions	Indicators
Notation Misconceptions	Misconceptions in simplifying fractions
	Misconception in ignoring the use of brackets
	Misconceptions regarding the use of fraction operation notation

The participants in this study consisted of five seventh-grade students who had completed instruction on fraction operations. Based on their problem-solving performance, the students were classified into three achievement levels: high, moderate, and low. The classification criteria, adapted from Malikha and Amir as cited in Sadiyah and Afriansyah (2023), are presented in **Table 2**.

**Table 2.** Students' problem-solving proficiency level

Criteria	Score
High	$80 \leq X \leq 100$
Moderate	$60 \leq X \leq 80$
Low	$0 \leq X \leq 60$

Although previous studies have extensively investigated students' misconceptions in fraction learning, limited attention has been given to analyzing misconceptions based on students' problem-solving performance levels. Therefore, this study classifies students according to their problem-solving performance and examines the characteristics of misconceptions exhibited by each group.

This study aims to analyze the mathematical misconceptions exhibited by seventh-grade junior high school students in solving fraction operation problems. Specifically, it seeks to provide a comprehensive description of the types of misconceptions experienced by students and to identify the possible factors contributing to their occurrence.

## METHODS

This study employed a descriptive qualitative approach to obtain an in-depth understanding of the phenomena experienced by the research participants, including their behaviors, perceptions, motivations, and actions. This approach emphasizes the comprehensive description of phenomena through words and language within their natural context. Data were collected using naturalistic methods to capture the conditions of the variables, themes, or phenomena as they occurred during the study (Aldianisa et al., 2021).

The study focused on analyzing junior high school students' misconceptions regarding fraction operations. Data collection was conducted on 10–11 May 2025. The participants consisted of five seventh-grade students enrolled in the 2024/2025 academic year from a junior high school located in Muara Labuh Village, Sungai Pagu District, South Solok Regency, Indonesia. The participants were selected using a purposive sampling technique.

Data were collected through two instruments: (1) an essay test on fraction operations designed to identify students' mathematical misconceptions, and (2) classroom observations conducted to support and validate the findings obtained from the written responses.

The essay test consisted of five open-ended questions covering fraction operations and was developed based on the misconception indicators proposed by Sadiah and Afriansyah (2023).

Students' responses were analyzed descriptively by identifying the types of misconceptions exhibited in each solution. The identified misconceptions were subsequently classified into three categories, generalization misconceptions, calculation misconceptions, and notation misconceptions, based on the framework proposed by Sadiah and Afriansyah (2023).

## RESULTS AND DISCUSSION

### Overview of Students' Performance

This study aimed to analyze the mathematical misconceptions exhibited by five seventh-grade junior high school students when solving fraction operation problems. Data were collected through an essay test consisting of five open-ended questions. Each question was scored on a scale ranging from 0 to 4, resulting in a maximum possible score of 20 for each participant.

The participants were selected using purposive sampling and were identified as Student 1, Student 2, Student 3, Student 4, and Student 5. Based on their problem-solving performance, the participants were classified into two achievement categories, namely high-performing and low-performing students, as presented in Table 3.

**Table 3.** Categories for Each Student

Name	Score	Category
Student 2	16	High
Student 5	12	High
Student 3	4	Low
Student 1	4	Low
Student 4	4	Low

The essay test consisted of five contextual problems involving fraction operations, including fraction addition, subtraction, representation of fractions as part of a whole, multiplication of fractions by whole numbers, and the application of fractions in everyday situations. Students' responses were analyzed according to three categories of misconceptions proposed by Sadiah and Afriansyah (2023): generalization misconceptions, calculation misconceptions, and notation misconceptions.

### Analysis of Students' Responses to Question 1

Table 4. Recap of Question 1

Student	Answer	Analysis	Misconception Type
Student 1	<p>Diket: Siti memakan kue di pagi hari = <math>\frac{1}{4}</math>            Siti memakan kue di sore hari = <math>\frac{2}{4}</math>            Ditanya: Berapa bagian kue yang dimakan Siti seluruhnya.            Jawab: <math>\frac{1}{4} + \frac{2}{4} = \frac{1+2}{4} = \frac{3}{4}</math></p>	<p>The process is correct, the denominators are equated, and the result is accurate, but the final conclusion and notation are missing</p>	MN (minimal notation)
Student 2	<p>diket: siti memakan kue di pagi hari = <math>\frac{1}{4}</math>            siti memakan kue di sore hari = <math>\frac{2}{4}</math>            ditanya: Berapa bagian kue yang dimakan Siti seluruhnya?            Jawab:  <math>\frac{1}{4} + \frac{2}{4} = \frac{1+2}{4} = \frac{3}{4}</math>            jadi: kue yang dimakan Siti seluruhnya yaitu <math>\frac{3}{4}</math> bagian</p>	<p>A complete, logical, and accurate answer</p>	-
Student 3	<p>1. Siti memakan <math>\frac{1}{4}</math> bagian kue di pagi hari dan <math>\frac{2}{4}</math> bagian kue di sore hari.            Berapa bagian kue yg dimakan Siti seluruhnya?            Jawab.  <math>\frac{1}{4} + \frac{2}{4} = \frac{3}{4}</math></p>	<p>Incorrectly converted the fraction and made an addition error</p>	MP & MH
Student 4	<p>Diketahui: Siti memakan kue di pagi hari = <math>\frac{1}{4}</math>            Siti memakan kue di sore hari = <math>\frac{2}{4}</math>            ditanya = berapa bagian kue yg dimakan Siti seluruhnya.            Jawab  <math>\frac{1}{4} + \frac{2}{4} = \frac{1+2}{4} = \frac{3}{4}</math></p>	<p>The process is correct, the denominators are equated, and the result is accurate, but the final conclusion and notation are missing</p>	MN (minimal notation)
Student 5	<p>diket: Siti memakan kue di pagi hari = <math>\frac{1}{4}</math>            Siti memakan kue di sore hari = <math>\frac{2}{4}</math>            ditanya: Berapa bagian kue yg dimakan Siti seluruhnya.            Jawab:  <math>\frac{1}{4} + \frac{2}{4} = \frac{1+2}{4} = \frac{3}{4}</math>            jadi: kue yg dimakan Siti seluruhnya yaitu <math>\frac{3}{4}</math> bagian.</p>	<p>A complete, logical, and accurate answer</p>	-

Question 1 required students to determine the total fraction of cake consumed by adding two fractions with the same denominator. As presented in Table 4, two students (Students 2 and 5) solved the problem correctly and provided complete contextual explanations, indicating a sound understanding of fraction addition. Students 1 and 4 also obtained the correct numerical answer; however, they failed to provide complete mathematical notation or contextual conclusions. Consequently, their responses were categorized as notation misconceptions.

The most substantial misconception was identified in Student 3, who transformed  $\frac{2}{4}$  into  $\frac{4}{2}$  and produced the incorrect expression  $\frac{1}{4} + \frac{4}{2} = \frac{4}{3}$ . This response reflects both generalization and calculation misconceptions. The student incorrectly treated fractions as whole numbers and failed to recognize the concept of equivalent fractions, leading to an answer that exceeded one whole despite the contextual limitation of the problem.

These findings suggest that low-performing students experienced greater difficulty distinguishing fraction procedures from whole-number operations. This tendency is consistent with the findings of Sadiyah and Afriansyah (2023), who reported that students frequently apply whole-number reasoning when solving fraction problems, resulting in conceptual and procedural misconceptions.

### Analysis of Students' Responses to Question 2

Table 5. Recap of Question 2

Student	Answer	Analysis	Misconception Type
Student 1	<p>Diket: - sepotong pita 1 meter            - Dina menggunakan <math>\frac{2}{5}</math> meter            Ditanya: Berapa meter pita yang tersisa            jawab: <math>\frac{5}{1}</math></p>	<p>The answer <math>\frac{5}{1}</math> indicates a complete lack of understanding of the concept of subtracting fractions</p>	MP & MH
Student 2	<p>Diket: - sepotong pita 1 meter            - Dina menggunakan <math>\frac{2}{5}</math> meter            ditanya: berapa meter pita yang tersisa            Jawab:  <math>\frac{1-2}{5} = \frac{1}{5}</math>            jadi: pita yang tersisa yaitu <math>\frac{1}{5}</math> meter</p>	<p>Incorrect, because 1 is greater than <math>\frac{2}{5}</math>. This indicates a misconception regarding the concepts of ordering and the value of fractions</p>	MH
Student 3	<p>diket:            - sepotong pita 1 meter            - Dina menggunakan <math>\frac{2}{5}</math> meter            Ditanya: berapa meter pita yg tersisa  <math>\frac{2}{5} - 1 = \frac{-1}{5}</math></p>	<p>The direction of the operation is incorrect. It should be <math>1 - \frac{2}{5}</math>, not the other way around. This indicates a misconception regarding the context of the operation</p>	MP & MH

Student	Answer	Analysis	Misconception Type
Student 4	<p>Diket = - 1 buah pitta  - 1 potong 8 bagian  - dimakan 3 bagian</p> <p>Ditanya: Berapa bagian pitta yang sudah dimakan Ani?  Jawab : 3</p>	The answer "5 meters" is irrelevant without the calculation	MH & MN
Student 5	<p>2. Dari sepotong pita sepanjang 1 meter, Dina menggunakan <math>\frac{2}{5}</math> meter utk membuat hiasan. Berapa meter pita yg tersisa</p> <p>Diket = - Sepotong pita 1 meter  - Dina menggunakan <math>\frac{2}{5}</math> meter</p> <p>ditanya = berapa meter pita yg tersisa  Jawab:</p> $1 - \frac{2}{5} = \frac{-1}{5}$	Similar to Student 2, this also shows misconceptions in understanding the value of fractions relative to whole numbers	MH

Question 2 assessed students' understanding of fraction subtraction in a contextual situation involving the remaining length of a wire. The results indicate that none of the participants answered the question completely correctly. Most students experienced either calculation misconceptions or generalization misconceptions, suggesting considerable difficulty in interpreting subtraction involving fractions.

Students 2 and 5 incorrectly concluded that  $1 - \frac{2}{5} = -\frac{1}{5}$ , indicating a misunderstanding of the relative values of whole numbers and fractions. Student 3 demonstrated a more fundamental misconception by reversing the intended operation and calculating  $\frac{2}{5} - 1$  instead of  $1 - \frac{2}{5}$ . Meanwhile, Student 1 failed to perform the subtraction altogether, whereas Student 4 produced an irrelevant answer ("5 meters") without showing any mathematical reasoning.

These findings indicate that students' misconceptions extended beyond computational procedures to include difficulties in interpreting contextual information. Similar findings were reported by Atiqoh and M. (2021), who argued that misconceptions often interfere with students' ability to select appropriate mathematical operations when solving contextual problems.

### Analysis of Students' Responses to Question 3

Table 6. Recap of Question 3

Student	Answer	Analysis	Misconception Type
Student 1	<p>Diket =  - 1 buah pitta  - potong 8 bagian  - dimakan 3 bagian</p> <p>Ditanya: Berapa bagian pitta yg sudah dimakan Ani?  Jawab : 3</p>	Simply writing 3, without expressing it as a fraction	MP & MN

Student	Answer	Analysis	Misconception Type
Student 2	<p>Diket: - 1 buah pizza - dipotong 8 bagian - dimakan 2 bagian</p> <p>Ditanya: berapa bagian pizza yang sudah dimakan Ani?</p> <p>Jawab: <math>\frac{3}{8}</math></p> <p>Jadi: Ani sudah memakan <math>\frac{1}{8}</math> bagian pizza.</p>	Correct, complete, and contextual answer	-
Student 3	<p>Diket: - 1 buah pizza - 1 potong 8 bagian - dimakan 3 bagian</p> <p>Ditanya: Berapa bagian pizza yg sudah dimakan Ani?</p> <p>Jawab: <math>\frac{3}{8}</math></p>	$\frac{3}{8}$ is correct, but it does not include the context or a conclusion	MN
Student 4	<p>Diket: - 1 buah pizza - 1 potong 8 bagian - dimakan 3 bagian</p> <p>Ditanya: Berapa bagian pizza yang sudah dimakan Ani?</p> <p>Jawab: 3</p>	Just like Student 1: only "3", without specifying the fraction	MP & MN
Student 5	<p>Diket: - 1 buah pizza - dipotong 8 bagian - dimakan 3 bagian</p> <p>Ditanya: berapa bagian pizza yg sudah dimakan Ani?</p> <p>Jawab: = 8</p> <p>Jadi: Ani sudah memakan <math>\frac{3}{8}</math> bagian pizza.</p>	The answer "8" indicates a complete misconception regarding the context of the problem	MP & MN

Question 3 required students to represent a part-to-whole relationship by expressing the number of students who did not bring their mathematics textbooks as a fraction of the total number of students. As shown in Table 6, only Student 2 demonstrated a complete and contextually appropriate response by correctly expressing the answer as  $\frac{3}{8}$  and providing an explanatory conclusion. Student 3 also obtained the correct fraction but omitted a contextual explanation, indicating a notation misconception rather than a conceptual misunderstanding.

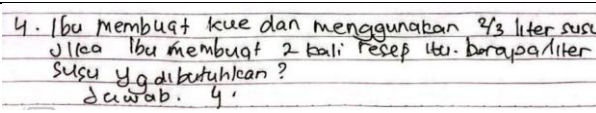
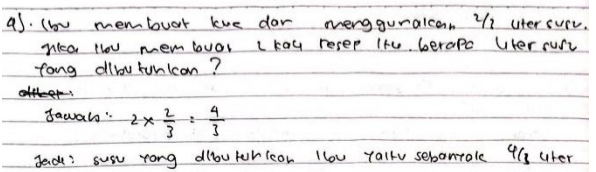
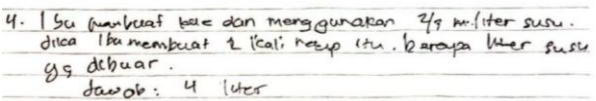
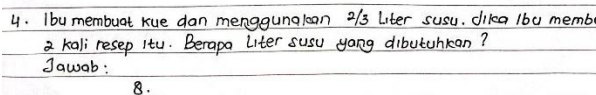
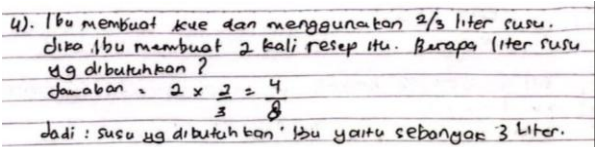
In contrast, Students 1 and 4 answered only 3, indicating that they recognized the number of students without textbooks but failed to represent it as a fraction of the entire group. This error reflects a generalization misconception because the students interpreted the problem using whole-number reasoning instead of understanding the concept of fractions as representing part-whole relationships. Student 5 exhibited the most fundamental misconception by answering 8, which represents the total number of students rather than the required fraction.

These findings indicate that several students experienced difficulty interpreting fractions within real-life contexts despite understanding the numerical information presented in the problem. This supports the findings of Nur'Ariyani (2023), who reported that students often focus on isolated numerical values rather than the conceptual meaning of fractions as representations of part-whole relationships. Therefore, mathematics instruction should

emphasize conceptual understanding of fractions in contextual situations rather than merely procedural computation.

### Analysis of Students' Responses to Question 4

Table 7. Recap of Question 4

Student	Answer	Analysis	Misconception Type
Student 1		An answer of "4" without showing the steps indicates a calculation error regarding basic concepts	MH
Student 2		Correct, complete, and contextual answer	-
Student 3		3/8 is correct, but it does not include the context or a conclusion	MH & MN
Student 4		Just like Student 1: only "3", without specifying the fraction	MH & MP
Student 5		The answer "8" indicates a complete misconception regarding the context of the problem	MN

Question 4 examined students' understanding of multiplying a fraction by a whole number in the context of determining the amount of milk required for two cake recipes. As presented in Table 7, Student 2 was the only participant who correctly performed the multiplication, obtained the result **4/3 liters**, and provided an appropriate contextual conclusion. This response indicates a sound understanding of both fraction multiplication and the interpretation of measurement units.

Most low-performing students demonstrated substantial calculation misconceptions. Student 1 wrote **4** without showing any calculation, suggesting that the student multiplied only the numerators while disregarding the denominator. Student 3 directly answered **4 liters**, indicating a failure to recognize that multiplying a fraction by a whole number still produces a fractional result. Meanwhile, Student 4 responded with **8**, an answer that bore no logical relationship to the information provided in the problem, reflecting both calculation and generalization misconceptions. Although Student 5 correctly calculated  $\frac{4}{3}$ , the final conclusion stated **3 liters**, revealing a notation misconception caused by an incorrect interpretation of the obtained result.

These findings suggest that many students relied on procedural intuition rather than conceptual understanding when performing fraction multiplication. Such misconceptions indicate that students have not yet fully understood the relationship between whole numbers and fractions in multiplication. Similar findings were reported by Ulfa et al. (2021), who emphasized that conceptual understanding of fractions is essential for accurately solving contextual mathematical problems involving fraction operations.

### Analysis of Students' Responses to Question 5

Table 8. Recap of Question 5

Student	Answer	Analysis	Misconception Type
Student 1		The answer "18 students" is a calculation error	MH
Student 2		Complete and accurate answer	-
Student 3		The answer "13 students" is incorrect	MH
Student 4		The answer "5" is illogical and does not fit the context	MP & MN

Student	Answer	Analysis	Misconception Type
Student 5	<p>5. Duri 30 siswa di kelas 5, <math>\frac{2}{5}</math> suka mata pelajaran matematika. Berapa banyak siswa yg suka matematika?</p> <p>Diket: di kelas 5, 30 siswa yg suka matematika <math>\frac{2}{5}</math></p> <p>Ditanya: berapa banyak siswa yg suka matematika?</p> <p>Jawab:</p> $\frac{2}{5} \times 30 = 12$	Correct result, but conclusion or units not written	MN

Question 5 required students to determine the number of students who liked mathematics by calculating  $\frac{2}{5}$  of 30. As shown in Table 8, Student 2 correctly applied the multiplication procedure, obtained the correct answer of **12 students**, and presented a complete contextual conclusion. Student 5 also produced the correct numerical answer but failed to include the appropriate unit and concluding statement, resulting in a notation misconception.

The remaining participants exhibited various misconceptions. Student 1 answered 18 students, while Student 3 wrote 13 students, both of which indicate calculation misconceptions because the results were inconsistent with the required multiplication of a fraction by a whole number. Student 4 responded with **5**, an answer unrelated to the mathematical context of the problem. This response demonstrates both generalization and notation misconceptions, suggesting that the student failed to interpret the fraction as representing a proportion of the total number of students.

Overall, the results of Question 5 reinforce the pattern observed throughout the study. Low-performing students experienced multiple misconceptions simultaneously, particularly calculation and generalization misconceptions, whereas high-performing students generally demonstrated adequate conceptual understanding and only minor weaknesses in mathematical communication. These findings are consistent with those reported by Sadiyah and Afriansyah (2023), who concluded that misconceptions in fraction operations are more prevalent among students with weaker conceptual understanding and lower problem-solving performance.

### Overall Discussion

Overall, the findings demonstrate that calculation misconceptions were the most frequently observed type among low-performing students, followed by generalization misconceptions and notation misconceptions. Students with lower problem-solving performance tended to exhibit multiple misconceptions simultaneously, whereas high-performing students generally demonstrated adequate conceptual understanding despite occasionally omitting mathematical notation or contextual conclusions.

The findings also suggest that misconceptions in fraction operations are primarily rooted in students' incomplete conceptual understanding rather than merely procedural weaknesses. Many students continued to apply whole-number reasoning when solving fraction problems, indicating that they had not fully internalized the fundamental properties of fractions. This observation supports previous studies (Sadiyah & Afriansyah, 2023; Nur'Ariyani, 2023), which

emphasized that misconceptions in fraction learning often originate from an overreliance on procedural knowledge without sufficient conceptual understanding.

From a pedagogical perspective, these findings imply that mathematics instruction should emphasize conceptual understanding alongside procedural fluency. Teachers should pay closer attention to students' reasoning processes and encourage them to communicate mathematical solutions completely by including appropriate notation, units, and contextual explanations. Such instructional practices are expected to reduce misconceptions and strengthen students' conceptual understanding of fractions.

## CONCLUSION

This study revealed that seventh-grade junior high school students continue to experience various misconceptions when solving fraction operation problems. Three major types of misconceptions were identified, namely **generalization misconceptions**, **calculation misconceptions**, and **notation misconceptions**. Generalization misconceptions occurred when students applied whole-number reasoning to fraction concepts, calculation misconceptions were reflected in incorrect computational procedures, and notation misconceptions were evident when students failed to present complete mathematical solutions, such as omitting appropriate units, symbols, or contextual conclusions.

The findings further indicate that low-performing students exhibited multiple misconceptions simultaneously, whereas high-performing students generally demonstrated better conceptual understanding and problem-solving performance. Nevertheless, some high-performing students still displayed notation misconceptions despite obtaining correct numerical answers, suggesting that mathematical communication remains an area requiring further improvement.

These findings highlight the importance of emphasizing conceptual understanding alongside procedural fluency in mathematics instruction. Teachers are encouraged to pay closer attention to students' reasoning processes rather than focusing solely on final answers. Providing learning experiences that strengthen conceptual understanding of fractions and encouraging students to communicate mathematical solutions completely and contextually may help reduce misconceptions and improve students' overall mathematical understanding.

This study involved only five participants from a single junior high school; therefore, the findings cannot be generalized to a broader population. Future studies are recommended to involve larger and more diverse samples and to employ additional data collection methods, such as interviews or think-aloud protocols, to gain a deeper understanding of students' reasoning processes and the underlying causes of mathematical misconceptions.

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## Declarations

- Author Contribution : Author 1: Conceptualization, Writing - Original Draft, Editing and Visualization; Author 2: Writing & Editing, Formal analysis, and Methodology; Author 3: Writing & Editing; Author 4: Writing & Formal analysis; Author 5: Writing & Methodology; Author 6: Validation and Supervision.
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- Additional Information : Additional information is available for this paper.

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