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Students' Difficulties in Understanding Fraction Concepts in Mathematics at Elementary School

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Abstract
This study aims to describe the various difficulties encountered by elementary school students in understanding fraction concepts in mathematics learning. A qualitative descriptive approach was employed to explore students' learning experiences in depth. The findings reveal that students' primary challenges include weak understanding of part–whole relationships, frequent errors in performing fraction operations, and difficulties in translating word problems into appropriate mathematical models. Furthermore, monotonous teaching methods and limited use of concrete learning media result in low student engagement and hinder the development of conceptual understanding. These results highlight the need for more varied, interactive, and contextual learning strategies—such as the use of concrete media and the PMRI approach—to support students in developing deeper and more meaningful understanding of fraction concepts.

Keywords: *Fractions; conceptual understanding; learning difficulties; elementary students.*

1. Introduction

Mathematics is one of the subjects that plays an important role in education because it functions to develop students' critical, logical, systematic, and analytical thinking skills (Ulfa, 2020). Through mathematics learning, students are trained to reason and solve problems that arise in everyday life (Firdaus dkk., 2021; Siswanto & Meiliasari, 2024). Therefore, a strong understanding of basic mathematical concepts becomes an essential foundation for students at the elementary school level (Safari & Nurhida, 2024). One of the topics that requires a solid mastery of concepts is fractions. In this topic, students are not only required to master procedural problem-solving skills but also to understand the meaning of fractions in real-life contexts so that they can apply them appropriately (Hidayati, 2012)

Fractions are recognized as one of the most challenging topics for elementary school students due to their abstract nature and the requirement to understand the relationship between parts and the whole. (Hidayatullah & Zainil, 2025; Primasari dkk., 2021; Van de Walle dkk., 2016). This complexity often causes students to experience difficulties in learning mathematics as a whole. (Putri dkk., 2025).

These difficulties arise because students often rely on memorizing formulas without understanding their conceptual meaning. (Gabriel dkk., 2013). There are many obstacles faced by students in learning fraction concepts, such as a lack of understanding of the meaning of fractions, weak computational skills, and difficulties in translating word problems into mathematical models. (Putri dkk., 2025). Low learning motivation and a lack of

variation in teaching methods further exacerbate these difficulties. (Syukra dkk., 2025a)

In addition, the use of monotonous teaching methods that are centered on the teacher's way of delivering the material has a significant impact on students' understanding. This is because students only receive instruction visually and without active involvement, resulting in shallow understanding. (Susanti dkk., 2024a; Wulandari, t.t.). Many teachers still use conventional approaches by repeatedly assigning practice problems without providing students with opportunities to explore or meaningfully reflect on mathematical concepts. (Sinaga dkk., 2023). Therefore, teachers need to understand the main causes of students' difficulties in learning fractions in order to determine effective, engaging, and everyday-life–relevant learning strategies.

To address these challenges, varied learning strategies that incorporate concrete media are required so that students can more easily visualize abstract concepts. The use of concrete media such as paper cut-outs, number blocks, and manipulative activities has been proven to help students understand relationships among values. (Amir & Andong, 2022; Shoimah dkk., 2021). In addition, the Indonesian Realistic Mathematics Education (PMRI) approach, which connects mathematical content to real-life contexts, is considered effective in improving students' understanding of fractions. (Mulyanti & Safari, 2025; Sukasno dkk., 2023). Through exploratory activities, concrete manipulation, and reflection, students can meaningfully construct fraction concepts, increase learning motivation, and develop the ability to translate word problems into mathematical forms. (Haloho dkk., 2019). Thus, the improvement of students' understanding of fraction concepts is influenced not only by their cognitive abilities but also by teachers' creativity in delivering interactive and relevant instruction.

To address various challenges and identify appropriate solutions, a deep understanding of the root problems faced by students is required so that the learning strategies implemented can become more effective and relevant. Therefore, this study aims to describe in detail and comprehensively the main obstacles encountered by elementary school students in understanding fraction concepts in mathematics.

2. Method

2.1. Research Design

This study used a qualitative descriptive approach with a library research design. The research focused on reviewing and analyzing relevant literature to describe elementary school students' difficulties in understanding fraction concepts in mathematics. This approach was selected to obtain an in-depth and systematic overview of existing findings without conducting field data collection.

2.2. Data Sources

The data were derived from secondary sources, including national and international journal articles, academic books, and previous research studies related to fraction learning difficulties at the elementary school level. All sources were selected based on their relevance to the research focus and credibility.

2.3. Research Instruments

The research instrument was a documentation guide, used to systematically record and organize information from selected literature. The guide focused on identifying types of learning difficulties, causes of misconceptions, and instructional factors related to fraction learning.

2.4. Data Collection Procedure

Data collection was carried out through a systematic document analysis. The literature gathering process involved searching reputable databases, specifically Google Scholar, ERIC, and DOAJ. The search was guided by specific keywords including: *'fraction difficulties'*, *'elementary mathematics'*, *'fraction misconceptions'*, and *'mathematical modeling'*. To ensure reproducibility, sources were selected based on predetermined inclusion criteria:

1. Publication Year: Articles published between 2015 and 2025 to ensure the findings are current.
2. Scope: Empirical studies specifically examining fraction learning in elementary schools.
3. Language: Articles written in English or Indonesian.
4. Type: Peer-reviewed journal articles and validated academic proceedings.

2.5. Data Analysis

Data were analyzed using qualitative descriptive analysis. The analysis process included data reduction, data organization, and conclusion drawing to obtain a comprehensive description of students' difficulties in understanding fraction concepts. To enhance the trustworthiness of the findings, source triangulation was applied by comparing information across multiple references.

3. Results and Discussion

The findings of the data analysis reveal that most elementary school students experience a range of challenges in understanding fraction concepts. (Syukra dkk., 2025b). These challenges include a weak understanding of basic part–whole concepts, difficulties in performing fraction operations, limited ability to interpret contextual problems, and a lack of variation in instructional strategies used by teachers in the classroom. These findings emphasize that fraction instruction requires learning approaches that facilitate the development of conceptual understanding through direct experiences rather than merely procedural memorization (Baharuddin, 2020). This is consistent with the view that fractions are one of the topics with a high level of complexity at the elementary school level, as they require the integration of symbolic, visual, and contextual representations. (Primasari dkk., 2021; Van de Walle dkk., 2016).

Table 1. Synthesis of Learning Difficulties, Causes, and Solutions

Type of Difficulty	Root Cause	Suggested Solution
Conceptual: Weak understanding of part–whole relationships.	Lack of visual representation and reliance on formula memorization.	Use concrete media (e.g., fraction blocks, paper folding) to visualize values.
Procedural: Errors in operations (e.g., adding denominators).	Applying whole-number rules to fraction operations.	Implement the PMRI approach to connect operations with real-life contexts.
Application: Inability to solve word problems.	Difficulty translating verbal text into mathematical models.	Practice with contextual storytelling and guided mathematical modeling.

Grade Level Differentiation.

Furthermore, the analysis suggests a clear distinction in misconceptions across grade levels. Lower elementary students (Grades 1–3) predominantly struggle with the fundamental part–whole concept, often misinterpreting the denominator as a whole number (for example, believing that $\frac{1}{8} > \frac{1}{6}$). In contrast, upper elementary students (Grades 4–6) encounter difficulties that are more procedural in nature, particularly in distinguishing between the rules for addition and subtraction (which require common denominators) and those for multiplication and division. This pattern indicates that instructional scaffolding should progressively evolve—from strong visual and concrete reinforcement in the lower grades to conceptual bridging and operational reasoning in the upper grades.One of the main findings of this study is students' limited understanding of the meaning of fractions as a relationship between parts and the whole. Students are not yet able to distinguish fraction values based on proportional reasoning, which often leads to misconceptions. For example, some students believe that the fraction 1/8 is greater than 1/6 because they assume that a larger denominator automatically represents a larger value. This misconception occurs when students lack sufficient experience with concrete representations to construct a conceptual understanding of fractions (Lamon, 2020). This finding is further supported by previous studies that indicate that (Author, 2024) which explain that relational understanding is essential for students to meaningfully perceive the connections among mathematical concepts, including fractions. The lack of visual representations in instruction also contributes to these difficulties, as students are not provided with opportunities to manipulate concrete objects as a bridge toward abstract understanding. (Gabriel dkk., 2013).

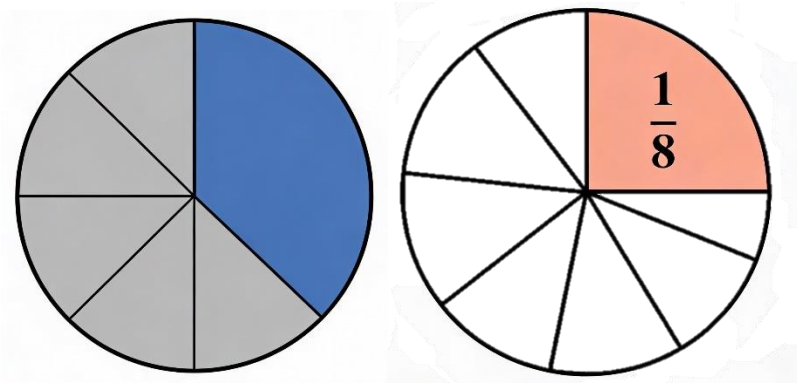

Figure 1. Visual comparison of fractions 1/6 and 1/8 illustrating that a larger denominator results in a smaller part, addressing common student misconceptions regarding value magnitude.

In addition, another difficulty identified is students' inability to relate concepts in mixed fraction operations, even though procedurally they are able to solve the problems. In practice, students often perform mixed fraction operations from left to right without considering the order of operations, in which multiplication and division should be prioritized (Author, 2020). This difficulty is also evident in students' errors when adding two fractions with different denominators, as they treat the operation as if it were similar to whole-number addition. For example, some students assume that $\frac{1}{4}+\frac{1}{3}=\frac{2}{7}$. This error indicates that students do not yet understand the role of the denominator in determining the number of equal parts. (Hidayatullah & Zainil, 2025) emphasizes that low proficiency in fraction operations stems from weak foundational understanding of fractions themselves. Therefore, fraction instruction should prioritize meaning-based understanding before progressing to procedural stages.

Difficulties are also evident when students are confronted with word problems. Most students are unable to identify essential information within the text, which makes it difficult for them to transform contextual problems into mathematical models. This challenge indicates that text-based problem-solving skills require the integration of language literacy, visual representation, and conceptual understanding (Panel, 2008). They are unable to connect verbal information to appropriate numerical or graphical representations. This condition aligns with the view that mathematical problem solving requires the integration of reading skills, information interpretation, and the ability to abstract concepts into mathematical symbols (Siswanto & Meiliasari, 2024). Therefore, instructional practices are needed that provide students with opportunities to practice interpreting texts and mapping information into fraction models.

Another finding that influences students' understanding is the tendency toward monotonous teaching strategies. Most teachers still employ traditional approaches, consisting of content explanation followed by repetitive practice exercises. Teacher-centered instruction tends to result in short-term memorization rather than deep understanding (Hiebert, 2007). This pattern causes students to merely follow instructions without independently exploring concepts. This observation is consistent with studies concluding that continuous one-way instruction can have a negative impact on students' interest and learning experiences (Susanti dkk., 2024). Ideally, fraction instruction should be conducted interactively, engaging students in discussion, object manipulation, and connecting concepts to real-life experiences.

The limited use of concrete learning media also exacerbates students' difficulties. Concrete media such as paper cut-outs, circular and square area models, or fraction blocks can help students visualize part–whole relationships more clearly. When students can see how a whole is divided into equal parts, they are better able to understand fraction concepts. The use of concrete media can increase student engagement during the learning process and strengthen their understanding of fraction concepts (Shoimah dkk., 2021). Thus, the use of visual aids is not merely supplementary but becomes an essential component in supporting the development of abstract understanding.

In addition, the implementation of the Indonesian Realistic Mathematics Education (PMRI) approach is considered relevant in helping students

understand fractions contextually. This approach connects the learning process with students' real-life experiences, enabling them to construct concepts through familiar everyday situations. Consequently, PMRI can enhance students' ability to relate real-world problems to mathematical concepts, including fractions (Sukasno dkk., 2023). Within this approach, students are given opportunities to independently discover fraction concepts through exploratory activities, group discussions, and reflection. As a result, the understanding developed becomes deeper because it is grounded in direct experience rather than merely teacher explanations.

Moreover, learning that is oriented toward students' active participation can enhance their problem-solving abilities. When students are involved in discussions, mathematical games, or manipulative activities, they are encouraged to think critically and analytically. This aligns with the view that mathematics learning should develop reasoning and problem-solving skills rather than merely procedural memorization (Firdaus dkk., 2021; Ulfa, 2020). Therefore, teachers need to design learning activities that provide students with opportunities to explore fraction concepts from multiple perspectives, thereby fostering more comprehensive understanding.

4. Conclusion

Based on the overall findings, it can be concluded that difficulties in understanding fractions are influenced by several interrelated factors. First, students' misconceptions regarding part–whole relationships lead to errors in evaluating fraction values. Second, weak mastery of fraction operations makes it difficult for students to solve more complex problems. Third, limitations in understanding word problems hinder the problem-solving process. Fourth, a lack of variation in instructional approaches reduces opportunities for students to develop understanding through direct experience. Fifth, monotonous and teacher-centered teaching methods result in low student engagement, making learning less meaningful. Therefore, to address these challenges, teachers need to implement meaningful learning through the use of concrete media and contextual approaches such as PMRI. This integration is expected to enhance learning motivation, strengthen conceptual understanding, and help students apply fraction knowledge in real-life contexts.

In the context of educational transformation, these findings imply a need for systemic changes. **Curriculum developers** should design learning trajectories that explicitly prioritize the transition from concrete manipulatives to abstract symbols. Additionally, teacher training programs must move beyond pedagogical theory to include practical workshops on creating low-cost, effective interactive media and managing student-centered inquiry classes. This holistic approach is essential to shift the paradigm from rote learning to deep conceptual mastery

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