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LEARNING OBSTACLES ON FRACTIONS: A SCOPING REVIEW

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ABSTRACT

This scoping review aims to consolidate the research that has been conducted on fractional learning challenges, with a particular emphasis on the various student groups, intervention strategies, outcomes, and specific learning problems. The research finds essential research topics and relevant papers and extracts data in order to gain an understanding of the intricate nature of fraction learning. The technique utilized in this study is a five-stage process. The preliminary literature searches produced a total of twenty-three articles, seven of which were chosen for a more in-depth examination. These publications covered a variety of themes, including the effectiveness of manipulatives, strategies for accommodating students who struggle with mathematics, focused training interventions, and instructor guidance. The findings of this research shed light on the myriad of difficulties associated with learning fractions. These difficulties range from basic conceptual and procedural comprehension to unique educational obstacles for a wide variety of student populations, including those with learning disabilities. The study focuses on a variety of intervention tactics, such as accommodations, strategic training, and the utilization of manipulatives, with the objective of enhancing problem-solving abilities, conceptual comprehension, and procedural proficiency in fractions. This all-encompassing examination highlights the ubiquity of misconceptions and the necessity of explicit training. It also highlights the usefulness of direct instruction, strategic education, and problem-solving exercises in improving students' comprehension of fractions. In order to overcome problems in learning fractions and to improve mathematical education, the findings advocate for the continuation of research and the incorporation of effective pedagogical approaches.

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1. INTRODUCTION

Students may struggle with fundamental concepts, operations, and problem solving when learning fractions. Several investigations provide evidence of common fractional learning obstacles. According to Fauzi and Suryadi (2020), students encounter ontogenetic,

epistemological, and didactic obstacles when learning fraction addition. Similarly, Hariyani et al. (2022) revealed that when solving fraction problems, students encounter epistemological barriers. Some studies attempt to elucidate these issues, such as Gabriel et al. (2013) claim that conceptual and procedural knowledge are essential components of fraction knowledge and that students may grapple with numbers and operations. Similarly, Yoshida and Sawano (2002) determined that students who received an intervention program that emphasized equal and equal division had a greater grasp of the representation of fraction size.

Students need more assistance in comprehending and correctly applying the concept of fractions; students have difficulty applying the concept of fractions in general. According to research by Ndalichako (2013), many Tanzanian students confuse the concept of fractions with the concept of whole numbers and tend to consider the numerator and denominator as separate entities. In addition, Gabriel et al. (2013) found that students struggle to comprehend fractional numbers and operations and frequently apply procedures that they do not fully comprehend. Similarly, Hasemann (1981) observed that many students only use memorized rules to solve fraction problems without understanding why the rules are effective. In addition, according to Brown and Quinn (2006), fraction manipulation errors are common among American students.

The landscape of mathematics education is marked by a myriad of obstacles that hinder students' progress and impede their ability to grasp and apply mathematical concepts. These obstcles, encompassing ontogenic, didactical, and epistemological dimensions, have been extensively explored. Ontogenic obstacles delve into mental readiness, didactical obstacles stem from teaching methods, and epistemological challenges arise from limited knowledge and understanding of concepts (Nopriana et al., 2022; Sari et al., 2018; Widodo & Ikhwanudin, 2019). Manifestations of these obstacles include difficulties in comprehending geometric shapes' volumes, underscoring the need for tailored didactical designs and teaching strategies (Safitri & Dasari, 2022).

Rachma and Rosjanuardi (2021) further categorize these obstacles into epistemological, ontogenic, and didactical, emphasizing the complexities students face in understanding mathematical concepts, psychological barriers, and issues arising from teaching methods (Sidik et al., 2021). The obstacles are compounded by the absence of media and learning resources, impacting students' learning experiences and impeding the implementation of ethnoconstructivism-based learning (Apriliawan & Parmiti, 2021; Elraiss, 2021; Suciati et al., 2021; Syahrial et al., 2020).

Central to the obstacles is the concept of mathematics anxiety, significantly influencing students' perception of mathematics as a daunting and uninteresting subject (Arianto et al., 2021; Kaba & Şengül, 2018). These obstacles extend beyond students; educators grapple with challenges in integrating technology, distributing books, and fostering Higher Order Thinking Skills (HOTS) in mathematics teaching (Abas & David, 2019; Kartika et al., 2019).

To address these multifaceted obstacles, a range of strategies have been proposed, including the design of learning materials based on mathematical communication, the use of assistive technology for visually impaired students, the implementation of hypothetical learning trajectories, and the development of pedagogical strategies (Daroni et al., 2018; Hendrik et al., 2020; Rosita et al., 2019). Moreover, considerations of obstacle learning, material hierarchy, and learning support capacity are advocated to enhance the efficiency of mathematics teaching and learning (Hendrik et al., 2020; Sekreter, 2018).

In the realm of junior high school mathematics, research has illuminated challenges in understanding fraction materials, with identified ontogenic, didactical, and epistemological obstacles (Bintara et al., 2020; Noto et al., 2020). Internal factors such as

achievement motivation and intrapersonal intelligence emerge as pivotal in influencing students' learning outcomes (Mastoni et al., 2019). The efficacy of problem-based learning, cooperative learning, and self-directed learning is underscored in enhancing mathematical abilities (Lei & Razali, 2021). The influence of learning materials, particularly mathematics textbooks, on students' learning experiences is emphasized (Kusaeri et al., 2022).

Furthermore, addressing students' emotional and cognitive challenges in mathematics learning is highlighted through studies exploring difficulty perceptions and the development of lesson plans to enhance communicative abilities (Mentari et al., 2018; Nishikawa & Izuta, 2019). The effectiveness of problem-based learning models, innovative teaching approaches, and students' proficiency in mathematics suggests the potential for overcoming learning obstacles (Abbas et al., 2021; Panjaitan & Suhendra, 2022). These findings collectively underscore the importance of holistic strategies, encompassing both pedagogical and emotional dimensions, to foster effective mathematics learning in diverse educational settings.

Common misconceptions about fractions exist among both students and instructors, and addressing these misconceptions is essential for effective fraction instruction and learning. Newton (2008) discovered that primary school instructors in their first year of teaching had limited knowledge of fractions, particularly in the areas of flexibility and transfer. Charalambous and Pitta-Pantazi (2007) identified five subconcepts of fractions (part-of-the-whole, ratio, operator, quotient, and measure) and discovered that students frequently struggle to comprehend the relationship between these subconcepts. Many participants, according to Ciosek and Samborska (2016), erroneously believed that the only method to obtain 1/n from a given whole was to divide the whole into n equal parts. Many teachers had difficulty with addition, division, and proportional reasoning involving fractions, indicating a lack of conceptual comprehension in this area (Ward & Thomas, 2007), who developed a tool to assess teachers' fraction knowledge.

Several researchers have found that explicit instruction, strategy instruction, and problem-solving activities are all effective fraction-teaching strategies. Misquitta (2011) discovered that stepwise sequences, strategy instruction, and direct instruction are effective for teaching fractions to struggling pupils. Naiser et al. (2003) identified effective strategies used by high school instructors to teach fractions, whereas Spangler (2011) outlined a powerful diagnostic method for analyzing student work and implementing timely interventions. Perdomo-Díaz et al. (2017) presented a professional development course that employed problem-solving activities, peer discussion, and supervisor intervention to enhance teachers' fractions-teaching mathematical knowledge.

Educators are able to build new learning assistance, including as multimedia, textbooks, and student worksheets, in order to assist students in solving their learning issues, particularly in relation to fraction-related subject matter. This can be accomplished through the process of investigating the obstacles that students face when learning. Therefore, this study's aim is to review the existing research on fraction learning difficulties by looking at the different groups of students studied, the different intervention strategies used, the results, and the specific learning problems that were encountered. The goal is to find effective practices and suggest directions for future research in mathematics education, especially in improving students' ability to understand and solve fraction problems.

2. METHOD

The proposed methodology served as the foundation for this scoping review. Five stages comprise the framework of this methodology (see Figure 1): (1) identifying research

questions, (2) identifying relevant studies, (3) selecting studies, (4) mapping data, and (5) compiling, summarizing, and reporting results (Arksey & O'Malley, 2005).

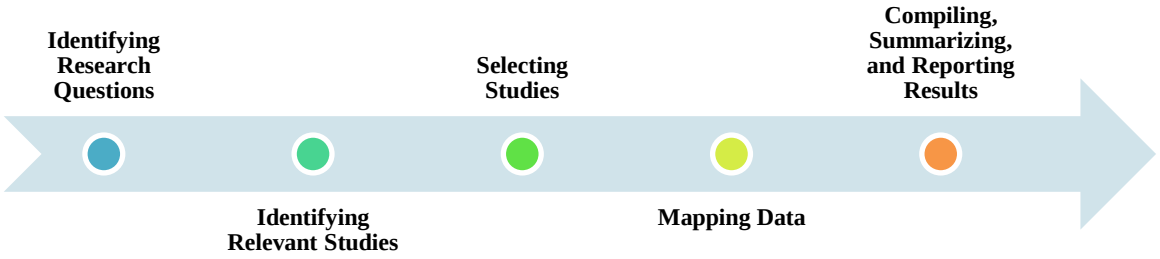

Figure 1. Scoping review procedure

2.1. Identifying Research Questions

The first step of the scoping review entails identifying the main area of interest and the essential research questions relevant to comprehending the difficulties encountered in fractional learning. The review aims to examine the specific characteristics of the participants or groups investigated, the methods or interventions used by researchers, the outcomes of these studies, and the specific learning difficulties in fractions noted by the authors. This stage is crucial for defining the extent of the review and directing following research endeavors towards pertinent areas.

2.2. Identifying Relevant Studies

A comprehensive literature review is done to identify and analyze the learning barriers associated with fractions. The search is refined by using keywords such as "learning obstacles," "learning difficulties," and "fractions," together with boolean operators (AND, OR). The chosen database for this search is Scopus, a comprehensive repository that provides a total of 23 articles. Among them, seven are considered extremely pertinent and chosen for thorough examination, showcasing the efficacy of the search method in identifying relevant studies.

2.3. Selecting Studies

The choice of papers is determined by certain criteria that prioritize the pertinence of each article to the fundamental issue of fractional learning difficulties. Out of the original selection, seven articles satisfy these requirements and are selected for thorough examination. The meticulous selection process guarantees that the review stays closely linked with its original study questions and aims.

2.4. Mapping Data

After selecting the appropriate research, the last step entails systematically organizing the data present in these papers. This involves classifying the subjects addressed, such as the effectiveness of manipulatives, approaches for supporting students with math difficulties, specific training interventions, long-term growth trends, teacher support in teaching fractions, constructivist teaching techniques, and obstacles to learning in elementary education. This mapping provides a thorough and all-encompassing summary of

the current research landscape, while also pinpointing any areas that have not been well studied and highlighting emerging patterns and directions in the field.

2.5. Compiling, Summarizing, and Reporting Results

Ultimately, the review concludes by gathering, condensing, and presenting the results. This entails a thorough examination that combines the information on fraction learning and instruction, offering in-depth understanding of different teaching methods, cognitive progress, and special difficulties encountered by groups of learners in this field of education. The result is a comprehensive report that not only emphasizes the present understanding but also proposes topics for more research and potential enhancements in teaching fractions.

3. RESULT AND DISCUSSION

Table 1 provides information on seven different research papers related to learning difficulties in mathematics, specifically related to fractions. The populations of these studies varied in terms of age, grade level, and the type of learning difficulties they faced. Hariyani et al. (2022) examined 30 fifth-graders from two elementary schools in Bandung City, Indonesia. Zhang and Rivera (2021) studied 23 middle school students with mathematical difficulties. Hansen et al. (2017) conducted a longitudinal study that involved 536 students from third through sixth grades. Zhang et al. (2016) did not provide information about the population from which they selected the 49 middle school students. Westenskow and Moyer-Packenham (2016) study involved 43 fifth-grade students with mathematical learning difficulties. Ding and Li (2014) did not mention the specific participants involved in their study. Instead, they analyzed data from three different cases to explore teacher guidance in student-centered classrooms when addressing a common learning difficulty with equivalent fractions. Peretz (2006) discussed a constructivist math curriculum for US elementary school teachers. The paper did not name any research participants. However, it is important to note that the sample size for some of these studies was relatively small, which could limit the generalizability of the findings.

Table 1. Subjects used by the researchers

Authors	Populations/Subjects
Hariyani et al. (2022)	30 fifth-graders.
Zhang and Rivera (2021)	23 middle school students.
Hansen et al. (2017)	Students in third through sixth grades, with a total of 536 participants.
Zhang et al. (2016)	49 middle school students.
Westenskow and Moyer-Packenham (2016)	43 fifth-grade students.
Ding and Li (2014)	Three different cases to explore teacher guidance in student-centered classroom.
Peretz (2006)	constructivist math curriculum for US elementary school teachers.

Table 2 presents an overview of seven research papers that focused on addressing learning difficulties related to fractions in mathematics. Each study had a unique intervention

approach to overcome the challenges faced by students while solving fraction problems. Hariyani et al. (2022) conducted a qualitative research and case studies to understand the fractional problem-solving challenges of elementary school children. Zhang and Rivera (2021) used a mixed-methods approach to examine the impact of specific accommodations on middle school students with arithmetic learning disabilities. Hansen et al. (2017) conducted a longitudinal study that aimed to identify the empirical growth classes and low-growth trajectory predictors among third to sixth-grade students. Zhang et al. (2016) used latent profile modeling to classify middle school students into fractional comparison problem strategic development tiers and provided multi-base strategic training interventions for students at different levels. Westenskow and Moyer-Packenham (2016) used a mixed-methods approach to examine how physical and virtual manipulatives could help students with arithmetic learning difficulties acquire equivalent fractions. Ding and Li (2014) analyzed teacher guidance in student-centered classrooms for equivalent fractions using three different scenarios. Finally, Peretz (2006) introduced a constructivist math curriculum for US elementary school teachers, which used a model of a "mathematical situation," physical processes, and physical language to improve students' mathematical reasoning. The interventions aimed to address various challenges faced by students in solving fraction problems, including exploring possibilities and quality, acquiring equivalent fractions, and improving mathematical reasoning skills.

Table 2. Methods or interventions

Authors	Methods or interventions
Hariyani et al. (2022)	This paper examined elementary school kids' fraction problem-solving challenges using qualitative research and case studies. Qualitative research seeks to comprehend the subject's thoughts. Case studies explain people, programs, processes, and other phenomena. This case study examined elementary school children' fractional problem-solving challenges.
Zhang and Rivera (2021)	The article assessed fraction problem-solving skills in middle school students with arithmetic learning disabilities using standardized testing. The testing condition comprised two specified accommodation supports. Three tests were given to the students: a baseline fraction test without accommodation, an annotated exam with bolded information and simplified explanations, and a warming-up test with whole-number multiplicative reasoning tasks before the baseline test. Explaining their answers was also required. A mixed-methods approach, including quantitative and qualitative data analysis, was employed to assess how accommodations affected student performance.
Hansen et al. (2017)	A longitudinal study examined third- through sixth-grade fraction knowledge growth. The sixth-graders were tested twice a year on fraction concepts and methods. They then identified empirical growth classes on each measures. The researchers also examined fraction concepts and processes' low-growth trajectory class predictors.
Zhang et al. (2016)	This paper uses latent profile modeling to classify students into fractional comparison problem strategic development tiers. Comparing fractions for student assessment. Multi-base strategic training interventions for students at different strategic development levels. Posttest, maintenance test, and generalization test to assess differential strategy training.

Authors	Methods or interventions
Westenskow and Moyer-Packenham (2016)	A mixed-methods study examined how physical and virtual manipulatives help students with arithmetic learning challenges acquire similar fractions. Pre/post testing and daily monitoring evaluations were used to assess pupil learning. Students learned five equivalent fraction sub-concepts and nine general fraction sub-concepts using an Iceberg Intervention Model. The study drew insights from quantitative and qualitative data.
Ding and Li (2014)	This report examined teacher guidance in student-centered classrooms for equivalent fractions. They examined three scenarios to determine how teachers' facilitating and direct guidance affected students' exploring possibilities and quality. Pretraining through worked examples and focusing on essential material and concept explanations were also found to be effective instructor supervision.
Peretz (2006)	The paper introduces a constructivist math curriculum for US elementary school teachers. A model of a "mathematical situation," physical processes, and a physical language are used to reason about pupils' math. The study addresses how teachers might utilize modeling to improve students' mathematical reasoning. The report does not discuss alternative research approaches.

Table 3 provides an analysis of seven research papers that aimed to address learning difficulties in mathematics, specifically related to fractions. Each paper had a unique intervention approach to solve these problems. Hariyani et al. (2022) found that elementary school children struggled with fractional problem-solving, including ideas, methods, and applications. Zhang and Rivera (2021) discovered that predetermined accommodations improved middle school students' unit thinking, reasoning, and coordination, enhancing their fraction task processing. Hansen et al. (2017) discovered that many special education pupils had difficulty learning fractions and identified predictors of low-growth trajectory fraction ideas and procedures classes. Zhang et al. (2016) found that tailored strategic training can increase problem-solving accuracy for students at different strategic developmental levels. Westenskow and Moyer-Packenham (2016) discovered that understanding the relationship between manipulative type and equivalent fraction subtopics can help intervention teachers employ manipulatives. Ding and Li (2014) found that teachers' enabling and direct coaching affected students' exploration opportunities and quality. Peretz (2006) suggests a constructivist math curriculum for US elementary school teachers-to-be to improve their mathematical reasoning attitudes. The interventions aimed to address different challenges faced by students in solving fraction problems, including problem-solving, unit thinking, reasoning, coordination, equivalent fractions, exploration opportunities and quality, and mathematical reasoning attitudes.

Table 3. Outcomes

Authors	Outcomes
Hariyani et al. (2022)	The report found that pupils struggled with fraction ideas, methods, and problem-solving. Problem-solving was the most challenge, as children struggled to apply fractions and count fractions. The study advises teachers construct appropriate didactic circumstances to avoid these difficulties in future fractional learning resources.

Authors	Outcomes
Zhang and Rivera (2021)	Predetermined accommodations, such as bolded material and simplified explanations, enabled middle school children with mathematics learning issues engage in unit thinking, reasoning, and coordination, which enhanced their fraction task processing. The study also found that a standardized evaluation with a "one-size-fits-all" accommodation did not suit the demands of all arithmetic learners.
Hansen et al. (2017)	The report indicated that third through sixth graders had separate fraction knowledge growth trajectory groups. Many special education pupils had difficulty learning fractions. Attention, whole number magnitude representation, and calculation fluency similarly predicted low-growth trajectory fraction ideas and procedures classes. These findings may impact mathematics instruction and special education.
Zhang et al. (2016)	The article found that fraction-solving strategies are highly linked with students' accuracy. The study found three strategic developmental levels for fraction comparison problems: cross-multiplication with the best accuracy, representation strategy with medium accuracy, and whole-number strategy with the lowest accuracy. The study also demonstrated that tailored strategic training can increase problem-solving accuracy for students at different strategic developmental levels. The differentiated strategic training intervention enhanced problem-solving accuracy in both groups of students.
Westenskow and Moyer-Packenham (2016)	Physical manipulatives were more successful for five sub-concepts, virtual manipulatives for four, and mixed manipulatives for two. Understanding the relationship between manipulative type and equivalent fraction subtopics can help intervention teachers employ manipulatives.
Ding and Li (2014)	The article found that teachers' enabling and direct coaching in anticipating and responding to student challenges affected students' exploration opportunities and quality. Pretraining using worked examples and focusing on essential material and concept explanations were found to be effective instructor supervision. In student-centered classrooms, combining facilitating and direct supervision can help students understand equivalent fractions, according to the study.
Peretz (2006)	The study suggests a constructivist math curriculum for US elementary school teachers-to-be. It lacks experiment or study outcomes. Instead, it explains how the technique may help future teachers and their pupils grasp math.

Table 4 provides information about seven research papers related to learning difficulties in mathematics, with a focus on fractions. Each paper is described by the authors, title, and the learning obstacle it addresses. The first paper by Hariyani et al. (2022) identifies a lack of knowledge of fractions, fractional arithmetic, and fractional difficulties as the primary learning obstacle for elementary school children. The second paper by Zhang and Rivera (2021) found that middle school pupils with math learning disabilities struggle with understanding simple fraction relationships, while the third paper by Hansen et al. (2017). reported poor language skills, concentration limitations, whole number line estimate issues,

and arithmetic fluency issues as common learning obstacles for special education pupils with learning impairments.

The fourth paper by Zhang et al. (2016) does not address specific learning difficulties but provides customized strategic training intervention to middle school children dealing with fractions. The fifth paper by Westenskow and Moyer-Packenham (2016) examines how different manipulatives can help students with arithmetic learning challenges acquire equivalent fractions. The sixth paper by Ding and Li (2014) addresses the confusion between "lines" and "pieces" as a common learning challenge with equivalent fractions. Finally, the seventh paper by Peretz (2006) constructivist method focuses on providing future teachers with a method to promote thinking and understanding of fractions in children, without discussing any specific learning barriers.

Table 4. Learning obstacles

Authors	Population
Hariyani et al. (2022)	Elementary school children confront fraction problem-solving challenges. Lack of knowledge of fractions, fractional arithmetic, and fractional difficulties are hurdles. Students struggle with comparing fractions with different denominators, equating denominators while adding and subtracting fractions, and translating fractional issues. The study advises teachers construct appropriate didactic circumstances to avoid these difficulties in future fractional learning resources.
Zhang and Rivera (2021)	Middle school pupils with math learning disabilities struggle to understand simple fraction relationships, according to the report. The study indicated that many of these pupils struggle with fraction magnitude awareness and knowledge, which impairs their ability to solve fraction problems.
Hansen et al. (2017)	Poor language skills, concentration limitations, whole number line estimate issues, and arithmetic fluency issues can all make learning fractions challenging, according to the report. Special education pupils, many of whom had learning impairments, also experienced low fraction knowledge growth.
Zhang et al. (2016)	No learning difficulties were addressed in the paper. However, the study focused on giving customized strategic training intervention to children dealing with fractions, suggesting that the researchers were trying to address any learning difficulties.
Westenskow and Moyer-Packenham (2016)	The paper did not address student learning challenges. The study examined how different manipulatives helped students with arithmetic learning challenges acquire equivalent fractions.
Ding and Li (2014)	The confusion between "lines" and "pieces" when utilizing number line models is a common learning challenge with equivalent fractions. This might make equal fractions difficult for children to understand and compare.
Peretz (2006)	The report does not discuss learning barriers. However, the constructivist method intends to provide future teachers more freedom in handling student inquiries and learning issues. The method promotes thinking and fraction understanding by providing a concrete foundation. Thus, it may help kids overcome math learning challenges.

The examination of learning obstacles linked to fractions reveals a complex landscape characterized by varied sample sizes and inadequate participant details, hindering the development of a comprehensive understanding (Ziadat & Sakarneh, 2022). To address this, the integration of existing curriculum proposals with individual-focused strategies, particularly those based on larger participant groups, emerges as a potential avenue for gaining a more nuanced understanding and providing effective support for students grappling with fractions (Beşaltı & Kul, 2021).

Despite the fragmented nature of past research, interventions targeting specific aspects of fraction learning demonstrate significant improvements in student outcomes. Noteworthy among these are interventions focusing on number line estimation, fraction concepts, and magnitude comparisons, all yielding meaningful effect sizes and underscoring the efficacy of these targeted strategies (Hariyanti & Hwang, 2020). Furthermore, the incorporation of authentic learning contexts and ubiquitous fraction apps positively influences collaboration and enhances learning abilities among students.

Addressing the multifaceted challenges associated with fractions necessitates a diverse and nuanced approach. Researchers such as Zhang et al. (2016), Westenskow and Moyer-Packenham (2016), Ding and Li (2014), and Peretz (2006) advocate for varied interventions, including strategic comparison training, the tackling of challenges like equivalent fractions, emphasis on teacher guidance, and the proposal of broader educational reforms. These findings highlight the necessity for a range of methods to tackle different obstacles in teaching fractions, ultimately assisting students in overcoming their struggles (Abreu-Mendoza et al., 2021; Akbaş, 2019; Copur-Gencturk & Doleck, 2021; Fauzi & Suryadi, 2020; Mukwambo et al., 2018; Ubah, 2021).

Drawing generalizations from previous studies, the effectiveness of diverse approaches in addressing varied challenges associated with teaching fractions is evident. While digital materials within course hours show promise, concerns arise for low and intermediate achievers lacking fraction sense (Ipek & Yaman, 2021; Kor et al., 2018). Anomalies in students' progression in learning fractions have been observed, and pre-service teachers exhibit varying levels of knowledge, particularly in fraction arithmetic (Baah-Duodu et al., 2019; Copur-Gencturk, 2021; Karlsson & Kilborn, 2022).

Despite persistent obstacles in fractions, targeted interventions focusing on strategic training and teacher guidance have proven effective in improving problem-solving accuracy and exploration opportunities (Ding & Li, 2014; Ristiana et al., 2021; Setambah et al., 2024; Setambah et al., 2021; Zhang et al., 2016). Proposed systemic shifts in teacher training present a holistic approach to address challenges comprehensively (Peretz, 2006). These findings align with previous studies emphasizing the importance of engaging students in mathematically meaningful actions, fostering creative mathematical thinking, and supporting the development of problem-solving strategies (Abuasad et al., 2019; Afrilianto et al., 2022; Morano & Riccomini, 2020; Papadopoulos, 2020).

The persistent challenges in problem-solving and comprehending equivalents posed by fractions are met with optimism through a comprehensive, multi-faceted approach encompassing targeted interventions and broader educational reforms. This integration of diverse strategies forms a pivotal pathway to address the multifaceted challenges linked to fractions, presenting a holistic framework to assist students in overcoming their obstacles.

4. CONCLUSION

The examined research studies, which focus on learning barriers in fraction mathematics, emphasize a range of difficulties and strategies for resolving these challenges among various student groups, such as primary and middle school students and those with

learning disabilities. These studies highlight the intricate nature of fraction learning, which is influenced by broader educational research. Students frequently have challenges comprehending core concepts, performing operations, and solving problems related to fractions. The implemented interventions encompass a variety of strategies, including accommodations, strategic training, and manipulative use, with the objective of addressing a wide range of concerns such as problem-solving, unit thinking, and the acquisition of comparable fractions. These findings align with the conclusions drawn by other scholars that highlight the complex nature of challenges in learning fractions. These challenges encompass various aspects such as ontogenetic, epistemological, and didactic barriers, as well as the importance of comprehending both conceptual and procedural aspects. Misconceptions prevalent among both students and instructors pose additional challenges in the realm of fraction teaching and learning, hence requiring the use of focused and explicit instructional approaches. The available research substantiates the effectiveness of many pedagogical methods, including direct instruction, strategy education, and problem-solving activities, in improving students' understanding of fractions. This thorough analysis emphasizes the necessity for ongoing investigation and the incorporation of efficient tactics to assist students in surmounting difficulties associated with fractions, fostering a more profound comprehension and use of fractional principles in mathematical education.

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