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Difficulties Experienced by Fourth-Grade Students in Fractions According to Teachers' Views

Sinem YANBIYIK[1]*, Mehmet Şaban AKGÜL[2], Burak SAZAK[3]

[1, 2]Assistant Professor, Tokat Gaziosmanpaşa University, Tokat, Türkiye
[3]Primary School Teacher, Tokat, Türkiye

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Author's Email :
sinem.yanbiyik@gop.edu.tr,
mehmet.akgul@gop.edu.tr,
buraksazak5@gmail.com

Author's Orcid :
0000-0002-7244-4933,
0000-0002-7257-5458,
0009-0006-9456-844X

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Abstract

The aim of this study is to identify the difficulties experienced by fourth-grade primary school students regarding fractions, based on the opinions of their classroom teachers. The research was designed as a case study within a qualitative research approach. The participants consisted of 16 classroom teachers who had previously taught fourth-grade students in Sivas and Kayseri provinces of Türkiye. They were selected using the criterion sampling method. Data were obtained from the responses to the question, "What are the difficulties that 4th-grade students experience regarding fractions? Please explain with detailed examples," posed to the teachers within a semi-structured interview form. The interviews lasted a total of 150 minutes, and the audio recordings were transcribed. The data were analyzed using content analysis; the 19 codes obtained as a result of the analysis were grouped under four themes. These themes are representation on a number line, fractions of a quantity and problem situations, modeling and representations, and conceptual-linguistic distinctions. The findings show that teachers most frequently emphasized showing mixed fractions on a number line and finding a given fraction of a quantity as the two areas of difficulty. In addition, modeling mixed fractions, comparing and ordering fractions, numerator-denominator separation, fraction language, identifying fraction types, and problem situations in the context of measurement are among the prominent areas. The study shows that the difficulties with fractions at the fourth-grade level are not only operational but also arise in terms of representation, magnitude, language, and problem-solving relationships.

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Introduction

Fractions constitute one of the first systematic steps in the transition from natural numbers to rational numbers in primary mathematics education. This topic is not limited merely to teaching how to name the parts of a whole; it also requires a range of multi-

dimensional skills, such as establishing relationships of magnitude, distinguishing equal parts, positioning on a number line, comparing, modelling and problem-solving. Consequently, fractions form a critical foundation for pupils' future learning of proportional thinking, decimal representation, percentages and algebra (Altun, 2015; Baykul, 2001). Indeed, the current primary school mathematics curriculum also includes, at Year 4 level, understanding the relationship between numerator and denominator, distinguishing between simple and compoundand mixed fractions, representing fractions on models and number lines, comparing fractions with equal denominators, determining the whole quantity corresponding to a given simple fraction and the simple fraction of a given quantity, and solving addition and subtraction problems involving fractions are explicitly highlighted (MEB, 2024).

The fourth-year level is a particularly critical threshold in terms of fraction teaching. This is because at this level, pupils are expected not only to recognise half, quarter or simple part-whole relationships, but also to transition between different representations, to think of a fraction as a quantity, and to establish relationships between quantities within a problem context. In other words, a student's understanding of fractions is not limited to being able to colour in shapes. They are also expected to be able to convert the verbal expression of a fraction into a symbolic representation, relate the model to the number line, and justify their choice of operation in a problem situation. In this regard, any shortcoming in fraction teaching can weaken not only immediate success but also subsequent components of mathematical thinking. Furthermore, the literature has long shown that fractions are among the topics where students face the most difficulty at primary school level. Research conducted in Turkey has revealed that pupils struggle with questions related to the definition of fractions, with the process of dividing into equal parts, and with writing a given fraction correctly (Haser and Ubuz, 2001). Similarly, it has been reported that students struggle to use appropriate representations in situations requiring comparison and ordering of fractions, particularly confusing the magnitude of numbers with that of fractions and making errors when transitioning between representations (Kılıç and Özdaş, 2010). Findings regarding the number line are also noteworthy. Pesen (2008) notes that students experience significant difficulties in the processes of dividing a whole into equal parts on the number line, identifying the fraction corresponding to a point, and relating the position of the fraction to the whole. Current research also supports this picture to a significant extent. Powell's (2023) study indicates that understanding fraction size must be developed particularly within the context of measurement and the fraction of a whole; Viegut and Matthews' (2023) findings, meanwhile, demonstrate that number line-based instruction is decisive in strengthening students' understanding of fraction size. In this regard, it is understood that the difficulties observed in fraction teaching cannot be reduced solely to procedural instruction; rather, conceptual, representational and linguistic dimensions must be considered together.

Teachers' perspectives hold particular importance in understanding the difficulties in teaching fractions. This is because classroom teachers can directly observe, through classroom observation and practical experience, the types of tasks where pupils struggle, which misconceptions become entrenched, and which explanations facilitate learning. This relationship between teacher knowledge and pupil learning is also clearly emphasised in current research. Copur-Gencturk (2021) demonstrated that teachers working at upper primary level can experience significant difficulties in providing conceptual explanations underlying fraction operations, and that this situation can directly affect students' learning opportunities. Ezaki, Li and Copur-Gencturk (2024), meanwhile, have highlighted that teachers should address their knowledge of fractions, ratios and proportional relationships not in isolation, but within an interconnected framework. Recent studies conducted within the Turkish context also indicate that teachers' perspectives are particularly important in terms of the early identification of difficulties in learning mathematics, the formulation of instructional interventions, and making the need for in-class support visible (Gül et al., 2024; Yılmaz et al., 2024).

Furthermore, recent studies indicate that postgraduate theses on fractions in Turkey largely

focus on the effectiveness of teaching models, strategies, techniques, or technology-supported applications; and that students are predominantly selected as the sample (Gözel, 2025). This situation highlights the need for studies that centre on teachers' classroom observations of fractions, particularly detailing which areas of difficulty emerge at the Year 4 primary school level. Furthermore, reviews of the current curriculum indicate that whilst learning outcomes for fractions are generally aligned with scientific learning pathways, certain stages—particularly in the areas of fractional arithmetic and problem-solving—are not structured in a way that is sufficiently clear for teachers (Güzel and Güzel, 2025). This situation makes it even more important to clarify areas of difficulty based on teachers' observations.

The aim of this study is to identify the difficulties fourth-year primary school pupils experience with fractions, based on the views of their class teachers. The central question addressed in the study is: According to class teachers, what difficulties do fourth-year pupils experience with fractions? The research aims to reveal how these difficulties are structured, particularly around the number line, problem situations, modelling and representation, and conceptual-linguistic distinctions. In this regard, the study contributes to the literature by demonstrating which content areas in fourth-grade fraction teaching, whilst appearing operational on the surface, are in fact intertwined with issues of representation and meaning-making.

Method

Research Design

This study was designed as a case study within a qualitative research approach. A case study is a research design that enables the researcher to examine a specific phenomenon within its natural context in a multifaceted manner (Creswell, 2007). The focus of the research lies in identifying the difficulties fourth-year primary school pupils experience with fractions through teacher observations. As the study focuses on a specific year group and a specific mathematical topic, it corresponds to a phenomenon with clearly defined boundaries.

Study Group

The study group consists of 16 primary school teachers working in the provinces of Sivas and Kayseri, or who have previously taught Year 4. In selecting the participants, criterion sampling and convenience sampling were used in conjunction. In criterion sampling, the primary criterion was that the teachers had taught or were currently teaching mathematics at Year 4 level. In convenience sampling, the researcher prioritised provinces and teachers to whom they had access. The provinces of Sivas and Kayseri were selected due to the ease of communication and access they provided during the data collection process. The interviews were concluded after 16 teachers, taking data saturation into account.

Data Collection Tool and Process

Data for the study were collected using a semi-structured interview form. During the data collection process, teachers were asked the following question: "What difficulties do Year 4 pupils experience with fractions? Could you explain this by providing detailed examples?" The interviews lasted a total of 150 minutes, were recorded using a voice recorder and subsequently transcribed. Participants were coded as P1–P16 to protect confidentiality. Details regarding the dates, settings, and the proportion of interviews conducted face-to-face or online were not reported. Similarly, the full set of questions in the interview form, the expert consultation process, and pilot study information were also not reported.

Ethical principles were observed throughout all stages of this study, and ethical committee approval was obtained.

Data Analysis

The data were analysed using content analysis, yielding a total of 19 codes from the interviews. The primary aim of content analysis is to identify recurring patterns of meaning in participants' statements and interpret these under conceptual clusters (Yıldırım and Şimşek, 2016). To highlight the research question, these codes were presented under four thematic frameworks: representation on the number line, fractions of a whole and problem situations, modelling and representations, and

conceptual-linguistic distinctions. In presenting the findings, the frequency of the most prominent codes was first provided, followed by direct teacher statements illustrating the relevant area of difficulty. Participants are coded as T1–T16 throughout the text and are referred to as class teachers.

Scope and Limitations of the Study

The study is based solely on teachers' views; no additional data sources such as pupils' written work, classroom observations or achievement tests were used. Consequently, the findings reflect teachers' classroom observations and interpretations rather than pupils' direct performance.

Findings

The 19 codes obtained through content analysis in the study are presented under four themes. Table 1 lists the areas of difficulty most frequently highlighted by teachers and the corresponding codes.

According to Table 1, the two areas of difficulty most frequently highlighted by teachers are representing mixed fractions on a number line (f=9) and finding a given fraction of a quantity (f=9). These two areas are followed by modelling mixed fractions (f=6) and comparing/ordering fractions (f=4). Although mentioned less frequently, areas such as distinguishing between numerator and denominator, identifying types of fractions, modelling mixed fractions, representing mixed fractions on a number line, and understanding problem language also feature in teachers' accounts.

Difficulties in Representation on the Number Line

The most prominent theme in the teachers' views is the difficulties students experience in the process of positioning fractions on the number line. This difficulty is particularly concentrated in mixed fractions. Nine teachers noted that students struggled to place mixed

Table 1: Key areas of difficulty regarding fractions, according to teachers' views

Theme	Code	f
Representation on the number line	Representing mixed fractions on the number line	9
	Representing mixed fractions on a number line	3
	Representing simple fractions on a number line	1
	Representing addition and subtraction of fractions on a number line	1
Fractions of a quantity and problem scenarios	Finding a given fraction of a quantity	9
	Establishing the relationship between a quarter and a whole in terms of weight/measurement	1
	Choosing the appropriate operation in fraction problems	1
	Relating problem data to unit fractions	1
Modelling and representations	Modelling mixed fractions	6
	Modelling mixed fractions	2
	Showing a fraction on a model	1
Conceptual and linguistic distinctions	Comparing/ordering fractions	4
	Inability to distinguish between numerator and denominator	2
	Inability to interpret the reading starting from the denominator	2
	Difficulty understanding the language/reading of fractions	1
	Inability to establish the whole-half-quarter relationship	1
	Inability to identify the type of fraction where the numerator and denominator are equal	1
	Difficulty in identifying types of fractions	1

fractions in the correct position on the number line. Some teachers suggest that this problem stems from students viewing the fraction merely as a 'broken-up shape' and being unable to conceive of it as a quantity.

Teacher 3's statement clearly illustrates this situation: "My pupils generally have problems on the number line. If they cannot grasp that simple fractions lie between 0 and 1, they struggle with mixed and mixed-whole number fractions. In particular, with mixed fractions, they confuse the positions of the numerator and denominator and cannot place them in the correct position on the number line." Similarly, T5 emphasises that the difficulty with mixed and improper fractions becomes particularly apparent with fractions greater than one: "They struggle particularly on the number line. They struggle with mixed and mixed-number fractions. Because it goes beyond 1, they struggle to find its position." Ö12 also supports this pattern, stating: "The thing they struggled with most was the representation of mixed fractions on the number line. They struggled to find their positions."

Under this theme, it is not only mixed fractions that are covered, but also mixed numbers and, to a more limited extent, simple fractions. Three teachers mentioned difficulties in representing mixed fractions on the number line, whilst one teacher noted that even with simple fractions, locating positions on the number line could be problematic. Furthermore, Teacher 11's statement indicates that the number line is challenging not only for positioning fraction sizes but also for representing operations: "I identified two points where the children struggled to understand. Firstly, they struggle to represent addition and subtraction on the number line." This finding suggests that the use of the number line is not merely a single-step representation problem for pupils; rather, it constitutes a multi-layered cognitive domain requiring the simultaneous establishment of relationships between magnitude, direction, interval and operations.

Finding a Fraction of a Quantity and Problem Situations

The second dominant theme in the teachers' views was the difficulties students experience in finding a given fraction of a whole and in understanding fraction problems. Nine teachers noted that students struggled particularly with problem situations involving 'a specific fraction of a whole' or 'reaching the whole from the given fraction'. This difficulty appears to result from a weak connection between the tendency to apply the operation mechanically and the ability to make sense of the problem context.

Teacher 1's statement illustrates this situation very clearly: "They struggled to understand and solve questions such as: 'They have read 3/5 of a book. If they read 10 more pages and 1/5 remains, how many pages is the book? They struggled to concretise and solve this type of question." Ö3 similarly notes that students often memorise the calculation rule, but that this rule does not work when the question is posed in the opposite direction: "They also struggle to find a fraction of a given quantity. They rely on rote learning. They divide by the denominator and multiply by the numerator. But in some questions, when asked in reverse, they get it wrong because of their reliance on rote learning." Teacher 15, meanwhile, states that both the dimension of "finding a specific fraction of a whole" and the dimension of "reaching the whole from a given part" are challenging for students.

Within this theme, there are also some sub-difficulties that occur less frequently but are considered important from an educational perspective. Ö11 explains the inability to conceptualise fractions in a measurement context as follows: "In fraction problems, they struggle to solve the question by assuming that concepts such as the 250 grams given actually represent a quarter of a kilogram." Ö14 notes that in fraction problems requiring addition, pupils tend to add the numerator and denominator together. Ö16, meanwhile, emphasises the difficulty of viewing the problem from the perspective of unit fractions, stating that students are unable to sufficiently establish the relationship between the quantity given in the problem and the concept of a fraction. When these findings are evaluated together, it can be said that the difficulty in formulating or solving problems stems not merely from procedural deficiencies, but from the need to grasp the relationship between the fraction as an operator, a measure, and a quantity simultaneously.

Modelling and Representations

The third key theme in the teachers' views concerns the difficulties encountered in the processes of modelling fractions and creating visual representations. Within this theme, modelling mixed fractions stands out in particular. Six teachers noted that pupils were unable to establish the relationship between breaking down, counting and selecting when modelling mixed fractions. Two teachers mentioned difficulties in modelling mixed fractions; one teacher, however, highlighted difficulties in generally representing fractions on a diagram.

Teacher 1's statement clearly illustrates the confusion in the modelling process: "They are struggling to model mixed fractions and mixed numbers. There is confusion over how many parts to divide into, which is the numerator and which is the denominator." Teacher 3 also highlights a similar issue: "They are having trouble modelling mixed fractions in particular. They do not know how to divide into as many parts as the denominator and select as many as the numerator. For example, they do not know how to divide 3/2 into 2 parts and select 3 parts." Teacher 4, however, links the difficulty in modelling to a problem in grasping "the concept of a whole and a part." This statement indicates that modelling difficulties are not merely related to drawing skills, but to the mental establishment of the whole-part relationship on which the fraction is based.

Another notable point within this theme is that some teachers particularly emphasise the need for materials and concretisation. While Ö4 states that "the topic of fractions is easier for children when explained concretely", Ö5 expresses that, due to the abstract nature of the subject, students need to "learn by doing and experiencing with objects". Ö9 also notes that material-based activities, such as folding paper, facilitate understanding the concepts of halves and quarters. These statements suggest that the difficulty in modelling is also closely related to the types of instructional support provided. In other words, the difficulty for students lies not merely in being unable to draw a fraction, but in understanding which whole the fraction represents and the logic of equal parts involved.

Conceptual and Linguistic Distinctions

The fourth theme in the teachers' views concerns the difficulties encountered in understanding fractional language and fundamental conceptual distinctions. The most frequently observed sub-theme under this theme is the comparison and ordering of fractions. Four teachers noted that, particularly with unit fractions or fractions with equal denominators, pupils tend to use whole number logic when establishing relationships of greater than and less than. Teacher 2's statement, "When asked whether 1/7 or 1/5 is larger, they generally say 1/7 is larger," provides a typical example of this misconception. Teacher 7 also states that students "fall into the misconception of thinking the fraction with the larger denominator is the larger fraction."

This theme is not limited to comparison alone. The inability to distinguish the functions of the numerator and denominator is another area of difficulty explicitly highlighted by the teachers. While Teacher 2 states, "They don't know where to write the numerator and denominator," Teacher 7 conveys the same issue in a different context by noting, "They struggle to determine whether to place the 3 in the numerator or denominator in a given fraction such as 3/5." The inability to interpret a fraction when its reading is given starting from the denominator—in other words, the inability to make the linguistic connection between the expression '2 out of 8' and '2/8'—was also highlighted by two teachers. Teacher 2's remark, "Even if they learn '2 over 8' correctly, they still struggle greatly to understand the expression '2 in 8'", highlights the importance of bridging the gap between mathematical language and everyday language in fraction teaching.

The theme also includes codes such as an inability to establish the whole-half-quarter relationship, an inability to identify the type of fraction where the numerator and denominator are equal, and an inability to distinguish between simple and compound fractions. Ö9 notes that, when no materials are used, students "cannot grasp that a whole is complete and intact" and cannot establish the half-quarter connection. Ö10 draws attention to the problem of naming fraction types, stating that "they could not determine that a fraction with equal numerator

and denominator must be a mixed fraction." Ö16's statement that "they struggle to label whether a fraction is a mixed fraction or a simple fraction" also supports this point. These findings indicate that the difficulty with fractions is not limited to specific tasks but is concentrated in processes such as the naming of concepts, the transition from linguistic form to symbolic representation, and distinguishing between types.

General Evaluation of The Findings

When evaluated together, the findings reveal that the difficulties with fractions at Year 4 level do not manifest as isolated clusters of errors; rather, they emerge within a structure that simultaneously encompasses representation, magnitude, language and problem-solving relationships. The fact that the difficulties most frequently mentioned by teachers centre on the number line and finding a fraction of a quantity suggests that pupils struggle to understand fractions not merely as a 'number of parts' but as an expression of magnitude and relationship. Modelling and conceptual-linguistic distinctions, meanwhile, appear to be the fundamental components underpinning these two dominant areas of difficulty.

Discussion

In this study, based on primary school teachers' views, it was observed that the difficulties fourth-year pupils experience with fractions are concentrated around four main themes: representation on the number line, fractions of a quantity and problem situations, modelling and representations, and conceptual-linguistic distinctions. The most striking aspect of the findings is that teachers most frequently highlighted representing mixed fractions on the number line and finding the given fraction of a quantity as the two main areas of difficulty. This result indicates that difficulties in fraction teaching cannot be explained solely by a lack of procedural skills; rather, it demonstrates that students experience disruptions in their processes of understanding fractions as magnitude, relationships and representations.

The emergence of difficulties in representation on the number line is consistent with the current emphasis in the literature. Viegut and Matthews (2023) demonstrate that number line-based instruction is a powerful tool for understanding the magnitude of fractions; however, for this tool to be effective, students must learn to think of a fraction as a single quantity. Teachers' accounts also reveal that, particularly with mixed and proper fractions, students struggle to make sense of fractions greater than one on the number line. The issue here is not merely a failure to 'place' the fraction. It is understood that students cannot align the multiple relationships between the numerator and denominator with the interval structure of the number line; consequently, they cannot conceive of the fraction as a point, an interval and a magnitude all at once. The fact that the transition from fraction strips to the number line is specifically recommended in the current curriculum demonstrates just how critical this representational leap is pedagogically (MEB, 2024). The findings suggest that when this transition is not systematically established in teaching, students struggle to determine the boundaries of the whole and the position of the fraction, particularly with mixed fractions.

The difficulties encountered in finding a given fraction of a whole and in inverse problem situations are also noteworthy. Teachers' comments indicate that students often develop an operational pattern; however, this pattern breaks down when the question is posed in the opposite direction or when relationships involving measurement, weight and unit fractions come into play. This finding highlights that fractions must be learned not only in terms of the 'part-whole' concept but also in terms of their role as an 'operator' and the 'relationship between quantities'. Powell's (2023) study demonstrates that framing the relationship between fraction size and the fraction of a whole from a measurement perspective enhances conceptual understanding. Similarly, the findings of this research suggest that the difficulties encountered in problem-solving situations often stem from a failure to grasp the quantitative transformative aspect of fractions. In particular, the difficulty experienced in questions of the type 'determining the whole from a given part' indicates that students struggle to readily establish the inverse relationship between the fraction and the whole.

Indeed, the fact that the process of determining the fraction of a whole and the process of reaching the whole from a given fraction are addressed within the same learning area in the current curriculum also highlights the pedagogical importance of this relationship (MEB, 2024).

Difficulties with modelling and visual representation can be considered another dimension underpinning these two dominant themes. It is significant that teachers highlight the confusion experienced in processes such as 'dividing into parts', 'selecting a fraction' and 'conceiving of multiple wholes within the same representation', particularly with regard to mixed fractions ( ). This finding indicates that students struggle to make sense of fractions not only symbolically but also visually and structurally. The findings regarding representations by Kılıç and Özdaş (2010) and the conceptual misunderstandings highlighted in Pesen's (2008) number line studies support this result. Current literature also emphasises that the ability to transition between different representations is central to the development of an understanding of fractional magnitude (Powell, 2023; Viegut and Matthews, 2023). In this study, the fact that some teachers emphasised the use of concrete materials and hands-on learning suggests that difficulties with modelling are closely related to the teaching environment. In other words, modelling is necessary not for students to 'see' the information, but to establish the relationship on which the fraction is based.

The theme of conceptual and linguistic distinctions highlights one of the key turning points in the teaching of fractions. The fact that pupils confuse the numerator-denominator distinction, are unable to convert expressions such as '2 out of 8' into symbolic notation, rely on whole number logic when comparing unit fractions, and struggle to distinguish between different types of fractions suggests that conceptual learning remains superficial. This finding is consistent with current debates regarding the quality of teachers' knowledge. Copur-Gencturk's (2021) findings indicate that teachers may also struggle to explain the conceptual rationale underlying fraction operations. Ezaki et al. (2024), however, emphasise that fractions, ratios and proportional thinking should be treated as interconnected structures. The teachers' narratives in this study reveal that pupils struggle to make sense of basic fraction language and types, whilst also suggesting a need for a more deliberate integration of conceptual explanation with the use of representations in teaching.

Another significant aspect of the findings is that teachers often define difficulties not within a single sub-topic but across interrelated processes. For example, a student experiencing difficulties on the number line may also confuse the numerator-denominator distinction, fail to model the problem, or select the wrong operation when solving a problem. This situation demonstrates that learning difficulties regarding fractions should be addressed not as a fragmented list of errors, but within an integrated conceptual framework. Reviews of the current curriculum also indicate that fraction teaching is generally aligned with the scientific framework in terms of learning outcomes, but that explanatory transitions for teachers could be strengthened, particularly in the arithmetic and problem-solving stages (Güzel and Güzel, 2025). This study concretises this need through the observational language of classroom teachers.

At this point, the pedagogical implications of the findings are also clear. Firstly, the transition from models to the number line in fraction teaching must be structured in a phased manner, rather than being haphazard. It is important for the pupil to first understand the concept of equal parts and then see how this same logic is maintained on the number line. Secondly, in problems involving finding the fraction of a given quantity, proceeding solely with one-way, formulaic questions does not appear sufficient. Problem situations constructed in the opposite direction, involving the measure-whole relationship and making the unit fraction concept visible, need to be used more systematically. Thirdly, the language of fractions must be explicitly addressed in the classroom; concepts such as numerator, denominator, unit fraction, and simple, compound, and mixed fractions must be examined not merely at the definitional level, but through representations and examples. Teachers' accounts indicate that part of the difficulty stems from the inability to establish a connection between the conceptual language and symbolic representation.

The contribution of this study lies in presenting fraction difficulties at the Year 4 primary school level within a selective and thematic framework based on teacher observations. Recent reviews indicate that most postgraduate studies on fractions in Turkey have focused on student samples and instructional intervention designs (Gözel, 2025). In this regard, such descriptive studies based on teachers' classroom experiences are important for identifying which content areas are more vulnerable within the teaching process. Indeed, recent studies focusing on the teacher's perspective also indicate that primary school teachers require greater support regarding mathematical learning difficulties and early intervention (Gül et al., 2024; Yılmaz et al., 2024). The findings of this study suggest that this need for support, specifically regarding fractions, is particularly concentrated in the dimensions of representation, language, and problem-formulation and -solving.

Conclusion

This study has highlighted the areas in which Year 4 pupils struggle most with fractions, based on the views of primary school teachers. The findings indicate that the most prominent difficulties centre on representing mixed fractions on a number line and determining the fraction of a quantity given. Furthermore, areas such as modelling, comparing and ordering fractions, distinguishing between numerators and denominators, fraction language and identifying types of fractions were also cited by teachers as notable areas of difficulty.

The study's key finding is that difficulties with fractions should not be viewed as independent clusters of errors, but rather as an integrated structure emerging at the intersection of representation, magnitude, language and problem-solving processes. This indicates that an approach based solely on teaching operations is insufficient in fourth-year fraction instruction; rather, it is necessary to establish conscious transitions between models, number lines, verbal expressions and problem situations. Teachers' views suggest that students struggle to move beyond superficial operational rules, particularly with mixed fractions, inverse problem situations and measurement-related questions. In this regard, it can be argued that the pedagogical priority in fourth-grade fraction teaching should be given to the solid establishment of the 'equal parts' concept, a gradual transition from models to the number line, problem situations that make the relationship between unit fractions and whole numbers visible, and the clear structuring of fraction language. This study systematically identifies the vulnerable areas of fraction teaching through teacher observations; it provides a concrete basis for discussion regarding both curriculum implementation and support processes for classroom teachers.

"The authors used ChatGPT (OpenAI) software under close human supervision for language editing. All academic content and results are the responsibility of the authors."

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Data and materials availability: The datasets and materials used and/or analyzed during the current study are available from the corresponding authors upon reasonable request.

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