TWIST

Assessing Grade 3 Learners' Current Level of Conceptual Understanding of Common Fraction Subtraction

A Case of OR Tambo Inland District Schools

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Abstract
Many grade 3 learners are expected to order, describe, and compare common fractions, including halves and quarters. However, they often struggle with fraction subtraction due to a limited conceptual understanding. This study investigates Grade 3 learners' current levels of understanding of common fraction subtraction in the OR Tambo Inland District. A mixed-methods approach was used, incorporating pre-tests and classroom observations across five primary schools. Data were analysed using a four-level performance framework: (1) ability to draw a fraction unit from a word problem, (2) write a fraction number from a word problem, (3) solve a common fraction subtraction problem, and (4) interpret a word problem symbolically and solve it correctly. The findings revealed that most learners were at levels 1 and 2, indicating basic and procedural knowledge, with only a small proportion demonstrating conceptual understanding at levels 3 and 4. Contributing factors included limited use of visual aids, inadequate teacher training, minimal use of technology like Google Classroom, and weak foundational number sense. The study recommends targeted interventions such as enhanced professional development, integration of technology, and instructional strategies grounded in constructivism to strengthen conceptual understanding of fraction subtraction.

Keywords
common fractions, conceptual understanding, assessment, constructivism, mathematics education

INTRODUCTION
The foundation for further mathematical reasoning is laid by the introduction of fractions, a crucial mathematical concept, in the early years of education. Common fractions, comprising comparison, representation, and subtraction operations, are expected to be understood by Grade 3 learners in South Africa according to the CAPS curriculum (Venkat, & Graven, 2024; DBE, 2011). However, many grade 3 learners struggle to meet these expectations, especially when it comes to subtraction activities, which frequently reveal underlying misconceptions resulting from procedural reliance and whole-number bias (DeWolf & Vosniadou, 2015; Siegler & Pyke, 2013). One of the five components of mathematical competency, conceptual knowledge is essential for helping learners understand the linkages and meanings of operations (Chen, 2024; Kilpatrick et al., 2001).

Given this, the current study uses a performance paradigm modified from Ismail and Mistima (2019) to examine the conceptual understanding of common fraction subtraction among Grade 3 learners in the OR Tambo Inland District. The framework divides learners' understanding into four diagnostic levels: Level 1: Ability to draw a fraction unit from a word problem task; Level 2: Ability to write a fraction number from a word problem; Level 3: Ability to solve a common fraction involving subtraction and Level 4: Ability to interpret a word problem in symbolic form and solve it correctly.

Both procedural skills and the ability to understand fractions as meaningful quantities are evaluated at these levels (Barbosa & Vale, 2021; Lee & Lee, 2023). Preliminary evidence indicates that most learners stay at the foundational levels (1 and 2), showing little progress toward abstract reasoning and symbolic manipulation (levels 3 and 4), according

to Dewi, Waluya, & Firmasari (2020). Therefore, the goal of the study is to determine the scope of these difficulties and their implications for education. Based on constructivist theory, the study promotes teaching methods that highlight contextual problem-solving, visualization, and manipulation to improve learners' comprehension of fractions (Venkat, & Graven, 2024).

Research Question
What is the Grade 3 learners' level of conceptual understanding of common fraction subtraction?

LITERATURE REVIEW
Fractions, particularly subtraction, present conceptual hurdles for young learners because they are abstract and contradict previous whole-number reasoning (Lee & Lee, 2023; Gabriel et al., 2023). Research emphasizes the necessity of using visual and contextual aids to enhance meaningful comprehension rather than just procedural teaching.

Framework for Conceptual Understanding.
Ismail and Mistima (2019) present a paradigm for identifying four incremental degrees of understanding fraction notions, which is consistent with the analytical methodology employed in this study. These levels, as refined by recent research (Barbosa & Vale, 2021; Lee & Lee, 2023), influenced the design and analysis of the learner pre-tests as follows: Drawing Fractions (Level 1): Learners are expected to exhibit fundamental recognition skills by visually depicting fractions from contextual exercises. Writing a Fraction (Level 2): Learners are expected to recognize and express fraction values from word problems, demonstrating early symbolic understanding. Solving Fraction Subtraction Problems (Level 3): Learners are required to perform subtraction processes, demonstrating intermediate comprehension. Interpreting and solution Symbolic Word Problems (Level 4): Learners should be able to translate contextual understanding into symbolic representation and accurate problem solution, demonstrating conceptual maturity. According to Resnick, Jordan, Hansen, Rajan, Rodrigues, Siegler & Fuchs, (2016), this paradigm is useful for both diagnostic and instructional purposes, supporting teachers as they scaffold learners through increasingly complicated levels of understanding.

Challenges in Understanding Fractions: Meaning of a Fraction
Understanding a fraction as a component of a whole, a position on a number line, or the outcome of division is fundamental (Lamon, 2012). However, many Grade 3 learners in the current study stayed at Level 1, demonstrating poor conceptual flexibility. According to Amland, Grande, Scherer, Lervåg, & Melby-Lervåg, (2025), insufficient utilization of visual aids and manipulatives can be a contributing factor, a concern that is also noticed in classroom settings.

Equivalent Fractions: Beyond Doubling
While some learners could write fractions, many struggle with equivalency, particularly when the denominators differ. This is consistent with Gabriel, Van Hoof, Gómez, and Van Dooren, (2023), who discovered that a lack of equivalency comprehension reduces problem-solving abilities. Instructional tactics based only on doubling impede deeper comprehension (Van de Walle et al., 2016).

Multi-step Subtraction Problems
At Level 3, learners are expected to carry out multi-step processes such as finding common denominators or converting mixed numbers. Nonetheless, many learners followed rote methods without grasping their reasoning (Amland, et., al., 2025; Venkat & Askew, 2018). This pattern was confirmed during classroom observations.

Early signs of fraction division and multiplication (Level 4)
Several Grade 3 learners usually see $\frac{1}{2} - \frac{1}{4}$ as $\frac{1}{8}$, which is unexpected. Such errors indicate a lack of conceptual clarity and highlight the importance of diagnostic assessment beyond formal curricular requirements (Moloto & Machaba, 2021).

Assessing Understanding of Fraction Subtraction
A variety of assessment approaches, including formative, diagnostic, and summative, help to determine where learners fall on the four-level framework. Diagnostic pretests employed in this study helped identify misconceptions early on, whereas the classroom observation provided insights into continuing improvement (Alfageh et al., 2024).

Conceptual Understanding and Constructivist Instruction
Conceptual understanding necessitates active interaction with mathematical concepts, which is aided by real-world applications and visualization (Van Hoof et al., 2017; Siegler and Pyke, 2013). The observed classrooms' inadequate use of digital tools like Google Classroom and manipulatives hampered such participation. Constructivist tactics that emphasize investigation, conversation, and contextual learning are therefore advised (Kotsis, 2025.; Ubah, 2021).

THEORETICAL FRAMEWORK
This study is based on constructivist learning theory, which states that learners acquire new knowledge by linking it to previous experiences (Kotsis, 2025; Chen, 2024; Piaget, 1952). Constructivism is especially important in understanding how Grade 3 learners build conceptual understanding of common fraction subtraction, a subject in which many rely on

rote techniques rather than conceptual reasoning. Constructivism holds that meaningful learning is active, contextual, and learner-centred (Taber, 2019). This framework defines learning as exploration, cooperation, material manipulation, and involvement with real-world challenges. This viewpoint is critical for understanding learners' progression through the four conceptual levels identified in this study: drawing fraction units from a word problem, writing fraction numbers from a word problem, solving common fraction subtraction problems, and interpreting and solving symbolic word problems.

These stages show a constructivist transition from concrete to abstract understanding. Chen, (2024) asserts that, young learners start by interacting with visual representations (e.g., sketching pies or bars) and progress to symbolic fluency (Level 4), which reflects a deeper conceptual grasp. The teacher's responsibility in this paradigm switches from giving instruction to enabling knowledge production, assisting learners with guided practice and formative feedback. Fraction bars, diagrams, and real-life contexts are examples of instructional materials that assist grade 3 learners in visualizing mathematical relationships. When utilized properly, digital platforms like Google Classroom can improve this process by creating interactive, visual, and collaborative environments that match with constructivist concepts (Sidney et al., 2021; Hasan, 2021).

Visual Representation in Fraction Subtraction

Visual techniques such as fraction pies and bars, which are especially useful at Levels 1 and 2, are frequently used to help learners understand fraction subtraction. For example, allowing learners to subtract $\frac{2}{5}$ from a whole represented as $\frac{5}{5}$ in a graphic helps them understand part-whole connections. However, many Grade 3 learners struggle to accurately interpret these models (Lee & Lee, 2023), emphasizing the importance of specific guidance and instructional scaffolding.

Example:
If you eat $\frac{2}{5}$ of a pizza, how much pizza is left? A visual diagram of a pizza divided into fifths is presented below.
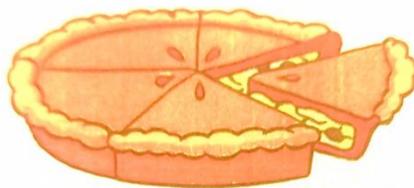

Fig. 1 Source author: Diagrammatic representation of fraction pie cut into fifths ($\frac{1}{5}$)

These visual activities must be linked to verbal reasoning and symbolic tasks to support transitions to Levels 3 and 4.

Misconceptions in Fraction Subtraction Among Grade 3 Learners

Learners commonly apply whole-number logic to fractions, resulting in mistakes (Deringol, 2019; Lortie-Forgues et al., 2015). These include considering numerators and denominators separately or believing that greater denominators represent smaller numbers without understanding the part-whole relationship.

Common Errors:
- $\frac{3}{5} - \frac{1}{2} = \frac{2}{3}$ (Failing to find a common denominator)
- $4 - \frac{3}{8} = \frac{4}{8} - \frac{3}{8}$ (Inappropriately assigning the denominator)

These errors frequently appear in Levels 2 and 3, indicating a lack of comprehension or an excessive reliance on computational techniques (Barbieri et al., 2021; Gabriel et al., 2023). Addressing them necessitates diagnostic evaluation and instructional strategies that prioritize conceptual development over procedural memorization.

Table 1 Misconceptions in Fraction Subtraction and Associated Errors (Gabriel et al., 2023)

Common misconception	Example of error
Failing to find a common denominator when adding or subtracting fractions with unlike denominators (Ubah, 2020)	$\frac{3}{5} - \frac{1}{2} = \frac{2}{3}$
Assuming a whole number has the same denominator as the problem's fraction (Moloto & Machaba, 2021)	$4 - \frac{3}{8} = \frac{4}{8} - \frac{3}{8}$

It is critical to assist Grade 3 learners in developing a sound conceptual foundation in fractions using the subtraction operation for success in mathematics. Understanding these common difficulties and employing effective, research-based techniques enables teachers to alter learners' math experiences and enhance their engagement (Jayanthi, Gersten, Schumacher, Dimino, Smolkowski & Spallone, 2021; Deringol, 2019).

METHOD RESEARCH DESIGN

This research used a convergent parallel mixed-methods design guided by a pragmatic paradigm (Creswell & Plano Clark, 2018; Schoonenboom & Johnson, 2017). The approach combines quantitative and qualitative data to provide a

complete picture of Grade 3 learners' conceptual understanding of common fraction subtraction. The quantitative component included pre-tests that were aligned with the four-level conceptual framework to determine learners' specific degrees of comprehension. The narrative data from the four categories gave qualitative insights into the teaching techniques that influence these levels.
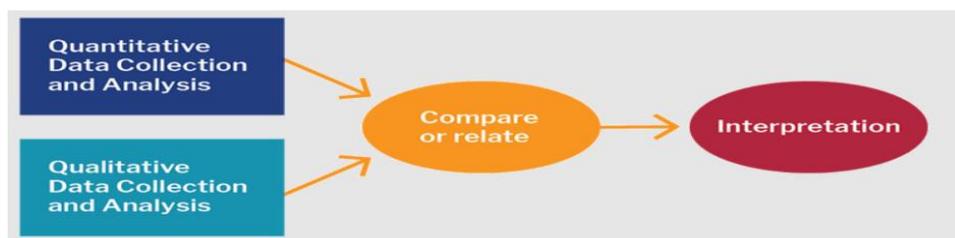

Fig. 2 Source authors: Mixed-Methods Framework

Quantitative data were descriptively analysed and classified into four diagnostic levels.
• Level 1: Drawing fraction units • Level 2: Writing fraction numbers • Level 3: Subtraction problems • Level 4: Symbolic word problems.

Qualitative data from the four categories were narratively analysed to investigate teaching strategies, resource use (e.g., visual aids, Google Classroom), and learner responses. The combination of the two strands provided triangulation and a better understanding of how teaching and environment influence conceptual learning progression (Jayanthi et, al.,2021).

Population and Sampling Technique
The study comprised Grade 3 learners from five purposefully selected primary schools in the OR Tambo Inland District. The sample size was 209 learners, distributed as follows: School A (42), School B (38), School C (46), School D (39), and School E (44). The selection focused on classes with observable arithmetic challenges, assuring relevance to the research question: What is *Grade 3 Learners' current level of conceptual understanding of Common Fraction Subtraction?* By focusing on these learners, the study provided insight into basic gaps and teaching strategies that influence advancement through the four levels (Venkat, & Graven, 2024; Ismail & Mistima, 2019).

Ethical Considerations
The University of the Free State (Ethical Clearance Number: UFS-HSD2023/2257) and the Eastern Cape Department of Education both provided ethical approval. Parents/guardians and schools provided informed consent for participation, which was entirely voluntary. Pseudonyms were used to protect learners' identities, and efforts were taken to reduce harm by developing rapport and trust during data collection (Suri, 2020).

Data Collection and Analysis

Data Collection
To assess Grade 3 learners' conceptual understanding of common fractions involving subtraction, a structured pre-test was designed and administered. The pretest was explicitly divided into four parts; each aligned with a specific level of conceptual understanding. Part A evaluated learners' ability to interpret a word problem in symbolic form and solve it accurately. Part B assessed learners' procedural skills in solving subtraction problems involving common fractions. Part C measured learners' ability to represent a fraction numerically from a word problem, and Part D focused on learners' capacity to construct a visual fraction model based on a word problem scenario.

This pretest was administered in five purposively selected primary schools within the OR Tambo Inland District. Each school contributed three Grade 3 classrooms, identified as having learners with generally low levels of mathematical conceptual understanding, consistent with the sampling strategy outlined by Ismail and Mistima (2019). A total of 209 Grade 3 learners participated in the assessment, which was conducted simultaneously across all sites with the support of class teachers.

Data Analysis Approach
To evaluate Grade 3 learners' conceptual understanding of common fractions involving subtraction, a diagnostic pre-test was administered. The test was deliberately structured into four sections, each designed to elicit responses aligned with a specific level of conceptual understanding. These levels were drawn from a hierarchical framework of mathematical cognition that moves from concrete to abstract reasoning. Learners' responses were manually graded for accuracy and classified into four hierarchical conceptual levels intended to reflect the depth of understanding. These levels were adapted from research frameworks on mathematical cognition and learning trajectories (Ismail and Mistima, 2019; and the works of Lamon, 2012) to provide a framework for identifying learners' developmental phases in fraction subtraction.

Data Analysis
Each learner's responses were manually coded and classified according to these conceptual levels. This classification enabled a structured analysis of how learners progressed across increasingly abstract cognitive demands in understanding fraction subtraction as shown in the distribution table below:

Table 2 Distribution of Learners Across Conceptual Levels (Source Authors)

Conceptual Level	Description
Level 4	Symbolic interpretation and correct solution
Level 3	Correct solution to subtraction problems
Level 2	Symbolic representation of fractions
Level 1	Visual representation of fractions

By aligning each pre-test part with a conceptual level, the analysis provided a clear diagnostic view of where grade 3 learners struggled most whether in concrete visual representations, symbolic reasoning, procedural fluency, or full symbolic interpretation. This framework formed the basis for identifying instructional gaps and learner misconceptions in the teaching and learning of common fraction subtraction (Ubah, 2020; Lortie-Forgues et al., 2015).

RESULTS

The results presented provide insight into Grade 3 learners' current levels of conceptual understanding of common fraction subtraction from the diagnostic pre-test completed by 209 respondents in five schools. The four levels by Ismail and Mistima (2019) served as a theoretical base to analyse data for this study. The data from the selected schools is presented descriptively and narratively to answer the main research question based on the four levels of conceptual understanding.

The research question is presented below with the four levels of conceptual understanding.

What is the Grade 3 learners' level of conceptual understanding of common fraction subtraction?

In answering the research question above, the levels of conceptual understanding are presented below, starting with level 4.

Level 4: Interpreting Word Problems and Solving Them Correctly

Learners operating at Level 4 were able to interpret a real-world context into symbolic form and correctly perform subtraction of fractions. In the task presented in Fig. 3 a below involving a cake cut into quarters, learners correctly subtracted numerators and maintained the denominator answers (Fig. 3).
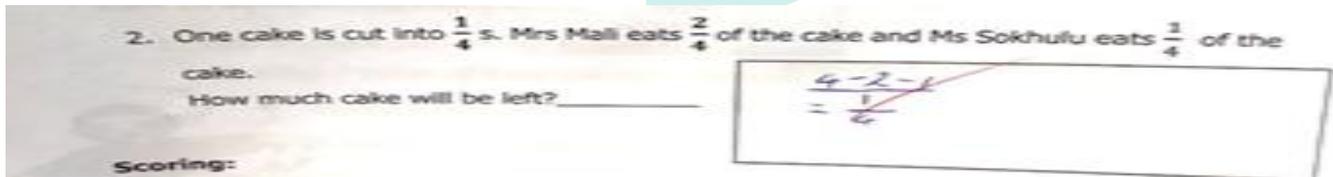

Fig. 3 Correct learner response at Level 4

Among the 209 participants, only 65 learners (31%) performed at Level 4 of conceptual understanding of common fractions. These learners were able to interpret fraction word problems and move to a symbolic representation and solve them successfully.

In contrast, 69% of the learners were not performing at level 4 of conceptual understanding on common fractions. Nonetheless, Amland, Grande, Scherer, Lervåg, & Melby-Lervåg, (2025), state that a significant gap in grade 3 learner`s ability to abstract and symbolically manipulate mathematical information from verbal contexts is a skill crucial for meaningful mathematical learning and problem solving. In contrast, Prior research confirms that learners often rely on procedural methods without fully grasping underlying concepts, particularly in fractions (Braithwaite and Siegler, 2021). Fig. 4 below shows that learners were able to change the word problems into symbolic form but struggled to subtract the fractions.
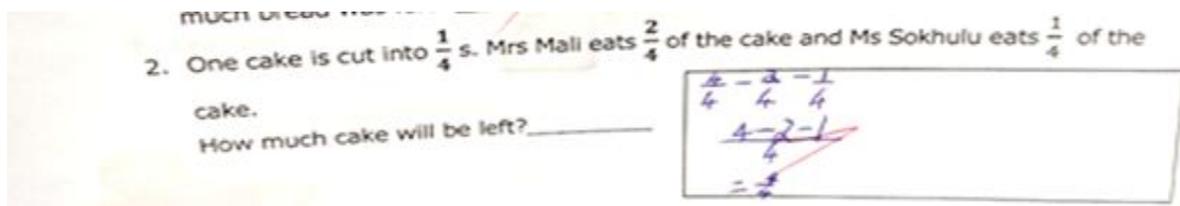

Fig. 4 Incorrect learner response at Level 4

Through qualitative analysis of 144 learners' written responses, three types of incorrect responses were identified: misinterpretation of fraction concepts, errors involving mathematical operations, and interpreting word problems into mathematical expressions. Each learner's error was carefully examined and coded based on recurring patterns observed across the scripts. These categories are presented thematically, supported by illustrative examples from learner responses, and linked to specific conceptual difficulties identified in the pretest tasks.

Misinterpretation of Fraction Concepts

This misinterpretation is evident in the pretest analysis of learners' responses, where many understood 'cut into fourths' as subtracting only the numerators (e.g., 4 – 2 –1=1), while completely omitting the denominators, as shown in Fig. 5 below.
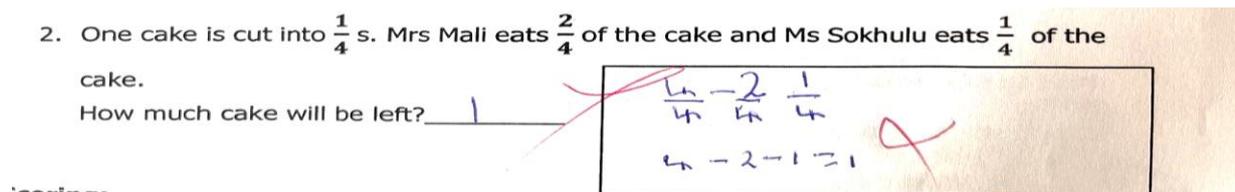

Fig. 5 Incorrect learner response at Level 4

This shows a conceptual misunderstanding of the part–whole relationship in fractions, where learners confuse the role of numerators and denominators. In this case, they treat the numerators as whole numbers to be subtracted directly (e.g., 4 – 2 – 1 = 1), rather than interpreting fractions as parts of a whole. Such errors reflect gaps in learners' foundational understanding of fraction concepts, aligning with findings by Gabriel et al. (2023), who observed that learners often rely on whole number reasoning when working with fractions. Similarly, Braithwaite and Siegler (2021) reported persistent difficulties among primary school learners in distinguishing between the numerator and denominator, suggesting that the findings of this study are consistent with broader research on conceptual challenges in learning fractions.

Errors in Mathematical Operations

This operation error was visible where 65 learners added the common fraction with subtraction operation. In agreement with, Yeo & Webel, (2024), grade 3 learners appear to apply familiar operations (such as addition) without interpreting the context of the problem, suggesting they have not fully developed an understanding of how subtraction applies to parts of a whole also as shown in Fig. 6 below.
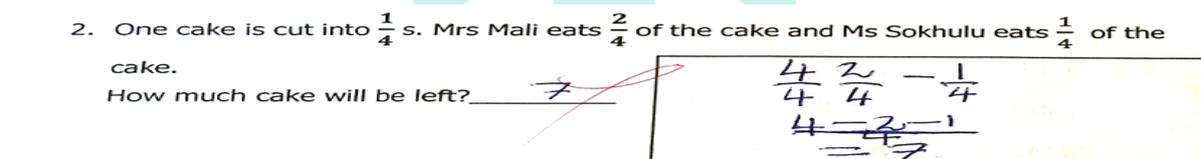

Fig. 6 Incorrect learner response at Level 4

This reflects a procedural misunderstanding and a lack of conceptual clarity about the meaning of subtraction in fractional contexts. This finding aligns with research by Amland, et al. (2025), who found that learners often confuse operations when working with fractions due to limited conceptual grounding.

Translating Word Problems into Mathematical Expressions

A quarter of the learners was unable to correctly translate word problems into mathematical expressions indicating a significant gap in their ability to connect linguistic information with appropriate mathematical representations as shown in the picture below:
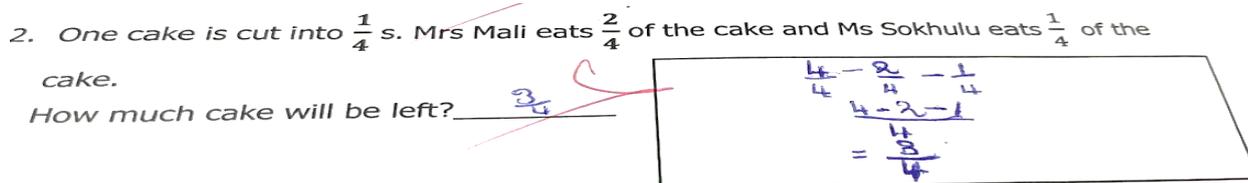

Fig. 7 Incorrect learner response at Level 4

Learners showed difficulty translating word problems into correct mathematical expressions, subtracting only numerators while keeping the denominator (e.g., $\frac{3}{4}$). This reflects limited semantic processing of mathematical language (Yeo & Webel, 2024) and aligns with Barbieri et al. (2021), who found that Grade 3 learners often misinterpret verbal problems. These findings highlight the need for instruction that bridges everyday language with mathematical symbols. The analysis now shifts to learners at Level 3, who performed fraction subtraction correctly but without full symbolic interpretation.

Level 3: Solving Subtraction Problems Involving Common Fractions

Data from the pretest demonstrated the learner's ability to solve a common fraction involving subtraction operations at level 3 of common fractions. A total of 88 learners (42%) were able to correctly solve common fractions at level 3 (Fig. 8).

Part B: Subtracting Fractions

1. Lulo shares a pie with her three friends.

    a) What fraction of a pie will each friend get?
        $\frac{1}{4}$

    b) What fraction of the pie is left for her three friends?
        $\frac{3}{4}$

Fig. 8 Correct learner response at Level 3

A total of 88 learners (42%) out of the 209 learners who wrote the test correctly answered part (numbered 1(a) and (b) of the test well, indicating a sound procedural grasp of subtraction involving fractions and by that they were able to translate the word problem into subtraction form. However, some learners exhibited persistent conceptual errors. The incorrect responses from Fig. 9 were categorized into three: misinterpretation of words into symbolic form, conceptual misunderstanding, and procedural errors lacking conceptual knowledge.

Misinterpretation of Contextual Language
Misinterpretation of contextual language was evident among 73 of the 121 learners who answered the problem incorrectly. For instance, in one task, several learners wrote an incorrect answer of $\frac{1}{3}$ rather than the correct $\frac{1}{4}$ as shown in the picture below:

Part B: Subtracting Fractions

1. Lulo shares a pie with her three friends.

    a) What fraction of a pie will each friend get?

Fig. 9 Incorrect learner response at Level 3

This suggests a breakdown not in mathematical computation but in understanding the contextual cues and language used in the problem. For this study, such findings indicate that learners' conceptual understanding of fractions is significantly influenced by their ability to interpret mathematical language accurately. While few studies focus specifically on this type of error, it may point to an underexplored area in mathematics education, how linguistic complexity in problem statements affects fraction (Barbieri, Young, Newton & Booth, 2021; Braithwaite & Siegler, 2021). According to this finding, numerical misconceptions e.g. (Braithwaite and Siegler, 2021; Lortie-Forgues et al., 2015) are not as prevalent as they often seem, especially in multilingual or linguistically diverse classrooms, where language interpretation plays a much greater role than it is often acknowledged.

Conceptual Misunderstanding
Out of the 121 incorrect responses, 48 learners failed to apply the basic rule of subtracting fractions with common denominators. Instead of retaining the denominator, they omitted it altogether and subtracted only the numerators, resulting in incomplete or incorrect answers as shown in Fig. 10 below:

    b) What fraction of the pie is left for her three friends?
        +3

Fig. 10 Incorrect learner response at Level 3

The above diagram highlights a prevalent conceptual misunderstanding learners demonstrated when solving subtraction tasks involving fractions. This reflects a misinterpretation of the fraction structure, as learners viewed fractions as two separate whole numbers rather than as a unified representation of part–whole relationships (Ubah, 2020). Furthermore, many learners misinterpreted the phrasing of the question, "What fraction of the pie is left?", and provided answers based on intuitive reasoning rather than applying formal subtraction principles. As illustrated in the diagram, these misconceptions reveal that the learners' understanding of subtraction in the context of fractions remains underdeveloped. They appear to rely more on surface cues from the problem statement rather than grasping the conceptual basis of fraction subtraction, thereby supporting Amland et al. (2025), who assert that such errors signify limited comprehension of the core mathematical structure underpinning fraction operations.

Procedural Errors
The data revealed that 121 learners out of 209, showed procedural errors when attempting part B, question 1(b) of the pretest, as they did not realize the correct answer for the task given as they gave the answer as $\frac{1}{3}$ instead of $\frac{3}{4}$, indicating reliance on memorized rules rather than understanding procedure. The implication is that learners rely on rote memory rather than genuine understanding as shown in the picture below:

b) What fraction of the pie is left for her three friends?

$$\frac{1}{3}$$

Fig. 11 Incorrect learner response at Level 3

This revelation from the learners' incorrect responses revealed distinct error patterns that offer critical insights into their conceptual misunderstandings of fraction subtraction. These error types reinforce the importance of assessing not only whether learners arrive at correct answers but also how they understand and process fraction subtraction tasks (Alfageh et, al., 2024). For this study, they provided a framework to analyze learner responses, diagnose learning gaps, and evaluate the effectiveness of digital instructional methods (particularly Google Classroom) in addressing and perpetuating these misconceptions. Following the identification of difficulties in solving fraction subtraction problems, the analysis proceeds to learners demonstrating Level 2 understanding, characterized by the ability to execute subtraction procedures correctly while lacking a comprehensive grasp of fraction symbolism.

Level 2: Representing Fraction Subtraction Symbolically
This level required learners to demonstrate their ability to represent fraction subtraction symbolically. At Level 2, learners were asked to subtract one fraction from another with like denominators (e.g., $\frac{5}{8} - \frac{2}{8}$. Only 32 out of 209 learners (15%) provided correct responses (Fig. 12).
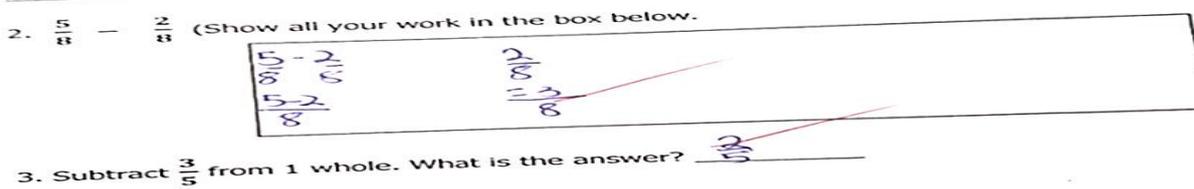
Fig. 12 Correct learner response at Level 2

Learners who succeeded at this level demonstrated understanding of basic rules for fraction subtraction, recognizing that only the numerators change while denominators remain the same, but some exhibited persistent errors. Some incorrect responses revealed a partial grasp of their ability to represent fraction subtraction symbolically. For instance, a learner subtracted the numerators but omitted the denominator, treating the problem as a subtraction of whole numbers (Moloto & Machaba, 2021) as seen in Fig. 13 below:
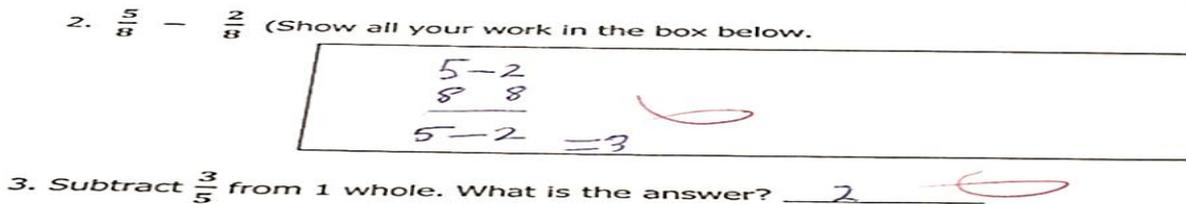
Fig. 13 Incorrect learner response at Level 2

This indicates the learner's ability to write a fraction number to represent fraction subtraction symbolically without a full conceptual grasp of fraction structure, consistent with earlier findings by Hwang, Yeo, and Son (2021), who identified similar difficulties in fraction subtraction among early learners.

Level 1: Visual Representation of Fractional Units
At this level, the assessment focused on learners' ability to translate a verbal instruction into a visual representation of a fraction (e.g., $\frac{1}{2}$). Results revealed that only 24 learners (12%) successfully produced correct diagrams. These accurate responses typically depicted a circle divided into two equal parts, with one part shaded (Fig. 14), reflecting a sound understanding of equal partitioning, a fundamental concept in fraction comprehension.
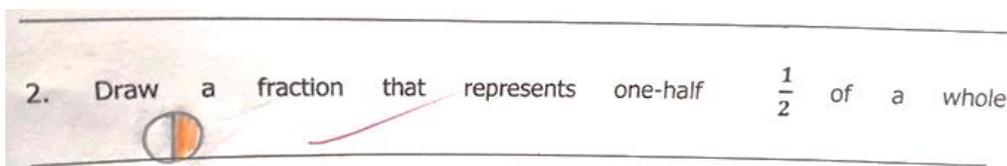
Fig. 14 Correct learner response at Level 1

The finding suggests a significant disconnect between learners' verbal interpretation skills and their ability to visualize fractions. The low success rate points to the need for instructional approaches that strengthen the link between language and visual representation in mathematics education. These results are echoed in broader research studies such as those by

Venkat, & Graven, (2024) and Amland, Grande, Scherer, Lervåg, & Melby-Lervåg, (2025) indicate that grade 3 learners often struggle with the concept of equal partitioning unless visual models are explicitly taught and reinforced. Therefore, this study not only highlights a key learning gap but also aligns with existing literature underscoring the critical role of representational fluency in developing a solid understanding of fractions.

However, at Level 1, many incorrect learner responses revealed significant misconceptions about the concept of fractions as equal parts of a whole. As shown in Fig. 15, one common error involved learners drawing shapes partitioned into unequal parts or shading areas incorrectly as shown below.
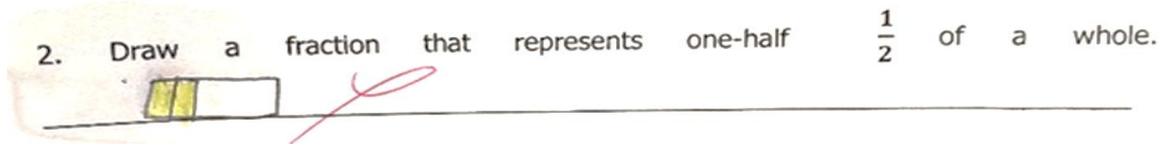

Fig. 15 Incorrect learner response at Level 1

For instance, in one case, a learner attempting to represent one-half ($\frac{1}{2}$) drew a rectangle divided into two sections, then subdivided one section into two equal parts and shaded both. This resulted in shading 2 out of 3 unequal parts, which mathematically does not represent one-half.

This error underscores a flawed understanding of equal partitioning a foundational concept in fraction learning. It suggests that while learners may recognize the need to divide a whole, they often lack a clear grasp of what constitutes equal parts. The unequal division evident in this response points to an emerging, yet incomplete, conceptual understanding of fractions. These findings echo previous research, such as Lazić et al. (2017), which emphasizes that misconceptions in part–whole relationships are common in early fraction learning. This reinforces the importance of explicitly teaching the principle of equal partitioning to support a deeper, more accurate conceptualization of fractions. These kinds of errors indicate the need for further development in visual-spatial reasoning, the concept of equal parts in fractions and there must be a clearer link between numeric and visual representations of $\frac{1}{2}$. The data analysis reveals a significant variation in learners' conceptual understanding of fraction subtraction. While a notable proportion operates at Level 3 and 4, a large number still struggle with foundational concepts such as translating verbal tasks into symbolic form, performing correct operations, and understanding visual partitioning (Moss & Brookhart, 2019).

FINDINGS AND DISCUSSION

This study investigated the conceptual understanding of common fraction subtraction among Grade 3 learners in selected OR Tambo Inland District schools. Using a diagnostic pre-test aligned with a four-level cognitive framework (Clements & Sarama, 2004; Ismail & Mistima, 2019), learner responses were categorized from basic visual modelling to advanced symbolic reasoning. Findings revealed that only a one- third of learners demonstrated Level 4 proficiency, involving correct symbolic abstraction and problem solving, while three-thirds showed difficulties with abstraction and mathematical language (Kotsis, 2025; Amland et al., 2025). At Level 3, the adequate number of learners performed procedural subtraction with like denominators, but the majority made errors due to linguistic misunderstanding and procedural confusion (Barbieri et al., 2021; Lortie-Forgues et al., 2015). Only a few learners were able to symbolically represent fractions at Level 2, although some were doing so incorrectly, as noted by Hwang, Yeo, and Son (2021). At Level 1, just very few learners accurately modelled fractions visually, with more learners displaying errors like unequal partitioning (Deringol, 2019; Lazić et al., 2017). Overall, the results confirm that many grade 3 learners are below the expected conceptual level and highlight the value of diagnostic tools grounded in cognitive theory to expose learning gaps and guide instruction, especially in digital environments like Google Classroom (Gabriel et al., 2023). These findings suggest an urgent need for instructional interventions that emphasize conceptual teaching, integration of language and mathematics, and visual-spatial reasoning in fraction learning.

RECOMMENDATIONS

Based on the findings, the following recommendations are proposed that, for learners to transition from concrete to abstract understanding, teachers should consistently use visual aids, such as fraction bars, pie charts, and number lines. According to Van de Walle et al. (2019); and Deringol, (2019), visual representation reinforces fraction concepts, particularly equal partitioning. Instruction should emphasize mathematical vocabulary and linguistic structures used in word problems. Teachers must explicitly teach learners how to decode word problems, a skill essential for bridging contextual scenarios and symbolic math (Barbieri et al., 2021). Teaching strategies must go beyond procedural instruction and engage learners in conceptual reasoning about fraction operations. Incorporating activities that explain "why" subtraction works with fractions will deepen understanding (Moloto & Machaba, 2021). Schools should use diagnostic tools aligned with conceptual levels to identify learners' current understanding and design appropriate interventions for each level. This differentiated approach enables tailored support (Ubah, 2020; Lortie-Forgues et al., 2015). And lastly, in collaboration with Yeo, (2020), Alfageh et al., (2024), advocate the use of web-based services such as Google Classroom to enhance conceptual teaching and collaborative planning. Google Classroom should include interactive fraction models, problem-based learning tasks, and formative feedback, rather than replacing tactile and verbal interaction (Jayanthi et al., 2021).

CONCLUSION

This study's findings revealed that grade 3 learners in the OR Tambo Inland District do not have a full conceptual understanding of common fraction subtraction. Although some learners displayed procedural mastery, few mastered higher-order skills such as symbolic interpretation and problem solving. Misinterpretation of fraction structure, visual misrepresentation, and language-related perplexity are among the errors detected, highlighting deep learning limitations. These findings also emphasize the necessity of matching curriculum and teaching to learners' conceptual development. Teachers must bridge the gap between visual, symbolic, and linguistic representations of fractions while guiding learners through each cognitive stage. Grade 3 teachers can dramatically improve fraction comprehension among their learners by using conceptually rich, language-sensitive, and visually grounded teaching techniques, as well as diagnostic evaluations and appropriate use of digital platforms. Future research may explore the longitudinal impact of such interventions and examine how digital learning environments like Google Classroom can be optimized to support learners' progression across conceptual levels in mathematics.

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