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Declaration form

By submitting this project research, I, Madhakasi Annacoleta**,** declare that this research project titled "**Learner's conception of a fraction: misconception and their possible mitigation measures."**, the work contained therein is my own, original work, that I am the sole author therefore the reproduction and publication by Bindura University of Science Education will not infringe any third-party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

December 2024

APPROVAL FORM

The following signatories certify that they oversaw and recommended for approval Madhakasi Annacoleta, " **Learner's reasoning/ conception of a fraction: misconception and their possible mitigation measures**," which was completed and submitted to **Bindura University of Science Education in Partial Fulfillment of the Requirements For Bachelor Honors Degree Science Education (HBScMaths) .**

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(Supervisor's signature) (Date)

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(Chairperson's signature) (Date)

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(Examiners 'signature) (Date)

DEDICATION

I dedicate this project to my family, whose unwavering support and encouragement have been my guiding light throughout this journey. To my husband, for instilling in me the values of hard work and perseverance and to my friends, who have always believed in my potential. This work is a testament to your love and encouragement.

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ABSTRACT

Understanding fractions is essential for mathematical proficiency, yet many students face significant challenges in this area. This study investigates learners' reasoning and misconceptions surrounding fractions at Jenya High School in the Chivi District, Zimbabwe. Utilizing a mixed-methods approach, data were gathered through classroom observations, written assignments, and semi-structured interviews involving 30 students aged 14 to 17. Findings indicate a high level of student engagement when utilizing visual aids and collaborative learning strategies; however, persistent misconceptions were identified, such as the belief that a higher numerator always indicates a larger fraction and the conflation of fractions with whole numbers. The role of the teacher as a facilitator emerged as critical in addressing these misunderstandings through inquiry-based learning and real-world applications. Furthermore, collaboration among peers significantly enhanced comprehension, allowing students to articulate their thoughts and rectify misconceptions collectively. The study underscores the need for tailored instructional strategies that address foundational understandings of fractions, emphasizing the importance of ongoing formative assessments and contextual learning. These insights contribute to the broader discourse on mathematics education in Zimbabwe, aiming to improve instructional practices and enhance learners' mathematical literacy in fractions.

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Chapter One: Research problem and its setting

1.0 Introduction

Understanding fractions is fundamental to students' overall mathematical proficiency. In recent years, educators have gained increasing insight into the myriad challenges learners face when grappling with fractions. This research seeks to explore learners' reasoning and misconceptions surrounding fractions at Jenya High School in the Chivi District. This study highlights the profound implications of these misconceptions on learners' academic performance and identifies possible mitigation measures to address the challenges.

1.1 Background of the Study

The teaching and learning of fractions are critical components of the Zimbabwean mathematics curriculum, especially at the secondary school level. As an educator with several years of experience, I have observed that many students struggle with even the basic concepts of fractions, leading to frustration and diminished confidence in their mathematical abilities. During classroom instruction, I have noticed that students often equate fractions only with division, neglecting the concept of parts and wholes. This narrow perception limits their ability to engage with more complex mathematical operations and applications involving fractions.

Recent evaluations by the Zimbabwe School Examinations Council (ZIMSEC) reveal concerning trends regarding students' comprehension of fractions. According to ZIMSEC reports, the overall pass rates in Mathematics have remained stagnantly low, with fractions often highlighted as a significant contributing factor to students' poor performance. This trend underscores the importance of addressing the root causes of students' misconceptions about fractions. The pervasive lack of conceptual understanding is not merely an isolated issue at

Jenya Secondary School; similar findings have been documented in other schools across the country, pointing to an urgent need for effective instructional methods.

Moyo (2018) emphasize the critical nature of foundational mathematical concepts and their role in shaping learners' ability to solve problems effectively. Makoni (2020) found that misconceptions surrounding fractions are often rooted in earlier mathematical experiences, largely deriving from inadequate primary school instruction in Zimbabwe. Furthermore, a study by Mugabi et al. (2021) highlighted that a significant number of secondary school students resort to rote memorization rather than true comprehension, which heavily impairs their capacity to apply critical reasoning in fraction-related problems. These findings resonate with anecdotal evidence from various schools where students grapple with both basic and advanced fraction problems.

Moreover, general pass rates associated with understanding and solving fraction problems have become increasingly alarming. The ZIMSEC statistics indicate a consistent decline in students' performance related to fractions over the past several years, with many learners unable to perform basic operations such as equivalent fractions, addition, and subtraction, let alone more complex concepts such as multiplying and dividing fractions. The implications of these findings are dire; without a solid grasp of fractions, students jeopardize their chances of success in further mathematics and even in STEM fields.

1.2 Problem Statement

Despite the recognized importance of fractions in mathematics education, a prevalent issue emerges: many students at Jenya High School lack a proper understanding or conception of what fractions truly represent. This deficiency manifests as significant misconceptions that hinder learners' ability to solve fraction problems, leading to persistently low performance in mathematics assessments. The crux of the problem lies not only in a lack of basic skills but also in an ingrained misunderstanding of fraction concepts, including their relationships to whole numbers and their applications in real-world scenarios.

The impact of these misconceptions is multifaceted, affecting students' confidence, motivation, and performance not just in mathematics but in other subjects that rely on quantitative reasoning. Therefore, addressing these fundamental misconceptions is paramount to improving the overall educational experience at Jenya High School and ensuring that students develop the mathematical literacy necessary for academic and life success. This study aims to delve deeply into these issues, exploring not only the nature of the misconceptions but also identifying effective strategies to mitigate their effects, ultimately paving the way for a more profound understanding of fractions among learners.

Through rigorous analysis and targeted interventions, the study aspires to contribute to the broader discourse surrounding mathematics education in Zimbabwe and enhance instructional practices that support learners in developing a comprehensive understanding of fractions.

1.3 Research Questions

To guide this study effectively, two central research questions will be addressed:

- First, what sort of misconceptions and errors are held by learners with respect to the idea of fractions? This inquiry will focus on identifying specific misunderstandings that prevent students from grasping the concept of fractions.
- Second, how can these misconceptions be lessened or reduced? Exploring targeted interventions forms the basis for developing strategies to enhance students' understanding and skills related to fractions. The importance of addressing these questions is underscored by the findings of Zhuwauka (2022), who highlights that

effective feedback and tailored instruction can play a significant role in remediating misconceptions among secondary school learners.

1.4 OBJECTIVES

1.4.1 To identify and document common misconceptions that learners have about fractions, including their understanding of fraction concepts notation and operations

1.4.2 To design and propose mitigation measures to address these common misconceptions about fractions including instructional strategies activities and assessments

1.5 Significance of the Study

This research is significant for several stakeholders in the education sector. By addressing the identified research questions, the study sheds light on the existing misconceptions surrounding fractions, thereby influencing pedagogical content knowledge for teachers. Enhanced understanding among educators can lead to better instructional methods and materials that accommodate learners' needs. Additionally, textbook writers can benefit from insights into common misconceptions by creating resources that directly address these gaps in understanding. By focusing on fractions, this study aims to provide educators and researchers with data that could inform future curriculum development and educational strategies in Zimbabwe and beyond. The relationship between strong foundational knowledge in fractions and success in further mathematical learning is critical, who assert that comprehension of fractions is crucial for learners' progression in mathematics.

1.6 Delimitations of the Study

This study will be conducted at Jenya High School located in the Chivi District, focusing specifically on the learners' understanding of fractions in the context of the early secondary school curriculum. The theoretical boundaries of this research will be confined to the concept of fractions and their associated operations. Furthermore, the study aims to target early secondary learners, approximately in the ages of 13 to 16 years old. Through this focused investigation, the research intends to generate a comprehensive understanding of the challenges faced by this specific demographic, paving the way for more tailored educational approaches.

1.7 Assumptions of the Study

The study operates under several assumptions that are pertinent to its focus on learners' understanding of fractions. It assumes that the emotional state of the students can significantly influence their engagement and competence in mathematics, as recent literature indicates a correlation between students' emotional well-being and their academic performance. Additionally, it presumes that individual and socio-economic factors, such as access to resources and prior educational experiences, play a role in shaping learners' conceptions of fractions. This will be essential in appreciating the broader context that underpins students' misconceptions.

1.8 Limitations of the Study

Like any research endeavor, this study is not without its limitations. Given the limited timeframe for conducting the research, the results may not encompass the broader student population beyond Jenya Secondary School. As such, generalizations across different contexts should be approached with caution. Furthermore, resource constraints might limit the variety of tools and strategies available for data collection, which could affect the depth and reliability of the findings. While qualitative insights will be prioritized, the study's outcomes may largely reflect the specific educational environment of the Chivi District rather than providing a comprehensive overview applicable across Zimbabwean schools.

1.9 Definition of Key Terms

1. **Mathematics Learning**: Mathematics learning refers to the process through which students acquire mathematical knowledge and skills, encompassing both conceptual understanding and procedural fluency. According to Van de Walle et al. (2020), effective mathematics learning involves building connections between different mathematical concepts, allowing for a deeper understanding of mathematics as a whole.

2. **Error**: In the context of mathematics, an error is an incorrect response or outcome in problem solving, often resulting from misunderstandings or miscalculations. As noted by Ginsburg (2021), errors can provide valuable insight into students' thinking processes and highlight areas where instructional intervention is needed.

3. **Misconception**: A misconception in mathematics is a deeply held belief or understanding that contradicts established mathematical principles. Research by Stylianides and Stylianides (2019) indicates that misconceptions often arise from inadequate conceptual understanding and can persist despite instruction, leading to further difficulties in learning mathematics.

1.10 Chapter One Summary

In this chapter, the foundational context of the research was established, highlighting the significance of understanding fractions in mathematics education. Personal experiences and observations pointed towards significant misconceptions prevalent among students at Jenya Secondary School, with implications for their overall academic performance. The chapter articulated the research questions guiding the study, underscored the significance of the findings for educators, and outlined the delimitations, assumptions, and limitations involved in the research. Lastly, key terms relevant to the study were defined to establish a shared understanding of the concepts that will frame subsequent discussions. Through this exploration, the study aims to contribute to developing effective strategies and interventions to mitigate learners' misconceptions concerning fractions.

CHAPTER TWO: LITERATURE REVIEW

2.1 Theoretical Framework

The theoretical framework for this study is grounded in several critical perspectives on mathematics education, particularly focusing on fractions. Understanding fractions is integral to mathematical competency and broader educational achievement. As various theorists suggest, a robust framework for teaching fractions encompasses both cognitive aspects and social interactions. This chapter will explore theoretical considerations surrounding fractions, alongside misconceptions and errors that learners commonly encounter, emphasizing how these insights can inform pedagogical practices.

2.1.1 Fractions: Theoretical Considerations

Understanding fractions involves grasping their conceptual foundations, which relate not only to numerical representation but also to proportional reasoning. According to Empson and Levi (2011), fractions symbolize division and can be understood through part-whole relationships. They emphasize that early exposure to these concepts significantly enhances learners' mathematical competence. Moreover, research by Behr, Lesh, Post, and Silver (1983) highlights that students struggle with fractions because they often do not connect the fractional representation to their understanding of whole numbers.

The study of fractions represents therefore an essential element of the mathematics curriculum making students' performance in it a barometer for student success in school. Dealing with fractions, unlike whole numbers, brings about numerical development and increases the students' knowledge in mathematics (Aqel et al., 2021). Its applications can be seen as both procedural and conceptual, whereby conceptual allows the student to classify fractions according to sizes, whereas procedural involves arithmetic skills. These arithmetic skills involve subtraction, addition, division and multiplication (Saban et al., 2021).

It is important to understand how procedural and conceptual fractions relate (Ozpinar & Arslan, 2021). Without understanding fractions as conceptual, it becomes difficult to understand fractions procedures and at the same time predict arithmetic problems associated with it (Braithwaite & Siegler, 2021). It will also be difficult to come up with required solutions or identify an unreasonable answer related to the arithmetic problem (Powell & Nelson, 2021). Copur-Gencturk (2021) examined the results of a sample of 20 students in grade 7 and concluded that difficulty operating arithmetic problem with fractions was still current, especially with the addition and subtraction of fractions having different denominators. A good example supporting this fact is when students were offered an arithmetic problem such as {1/5+2/6=□}, students approached the problem by adding numerators (1+2) and denominators (5+6), resulting to (3/11) as their answer (Xu et al., 2021). These misconceptions can be seen in almost all schools globally. This disconnect can lead to persistent misconceptions. Effective instruction should therefore bridge these gaps, ensuring that students develop a comprehensive understanding of fractions as dynamic entities rather than static symbols.

2.1.2 Constructivist Learning: Teachers as Facilitators

The constructivist paradigm posits that learners actively construct their own understanding and knowledge of the world through experiences and reflecting on those experiences (Bruner, 2019). Within this framework, teachers are viewed not merely as transmitters of knowledge but as facilitators who guide students in their learning journeys. According to Urhahne (2018), teachers who employ constructivist strategies encourage students to collaborate, explore, and engage deeply with mathematical concepts, including fractions. This participatory approach can lead to improved comprehension as learners work through problems collectively. Research has consistently shown that when teachers adopt facilitative roles, students demonstrate more significant interest and understanding of mathematical concepts, providing a pedagogical pathway to alleviate misconceptions about fractions (Hattie & Timperley, 2018).

1. The Role of the Teacher in Constructivist Learning

In a constructivist classroom, the teacher's role is multifaceted. Rather than delivering information through direct instruction, teachers design learning experiences that encourage students to explore, question and draw connections between concepts. According to Bruner (1996), effective teaching involves creating a learning environment that helps students discover knowledge on their own through guided discovery methods. For instance, in a lesson on fractions, a teacher might set up a series of hands-on activities using physical objects such as pie charts or fraction tiles, thereby allowing students to manipulate and visualize the concepts they are learning.

Furthermore, the constructivist approach requires teachers to recognize and build upon students' existing knowledge and experiences. This involves assessing students' prior understanding of fractions and using this information to tailor instruction to meet individual needs. As noted by Cohen (2016), the teacher's ability to connect new knowledge with what students already know facilitates deeper understanding and retention, particularly with abstract concepts such as fractions.

2. Promoting Student Agency and Ownership of Learning

A key tenet of constructivist learning is fostering student agency, whereby learners take ownership of their educational experiences. Teachers as facilitators empower students to take responsibility for their learning by allowing them to engage in problem-solving and critical thinking activities. This involves transitioning from a teacher-centered to a student-centered classroom, where learners are encouraged to voice their thoughts, ask questions, and collaborate with peers.

In the context of learning fractions, for example, students might be given real-world scenarios—such as cooking or budgeting—that require them to apply their knowledge of fractions. In these situations, teachers facilitate discussions and guide students to explore various methods of problem-solving while encouraging them to evaluate their strategies critically. Such approaches promote a sense of autonomy, allowing students to develop their reasoning abilities and mathematical skills organically.

3. Collaboration and Social Interaction

Constructivist learning emphasizes the importance of social interaction in the knowledge-building process. Vygotsky's (1978) social constructivism highlights the significance of collaborative learning, where students discuss and negotiate their understanding of concepts with peers. In this role, teachers facilitate group work, promoting peer-to-peer interactions that can enhance comprehension.

When studying fractions, for example, students could work in small groups to solve problems collaboratively. Teachers can facilitate this process by providing guidance on how to communicate mathematical ideas effectively, challenging students to articulate their reasoning and justify their answers. Research by Johnson and Johnson (2017) shows that such collaborative environments allow students to learn from one another, clarify misunderstandings, and develop higher-order thinking skills. This peer interaction can be particularly effective in addressing misconceptions regarding fractions, as students often benefit from hearing explanations and reasoning from their classmates.

4. Differentiated Instruction and Flexible Grouping

In a constructivist framework, teachers must also adapt instruction to meet the diverse needs of learners in their classrooms. Differentiated instruction—tailoring learning experiences to suit varying levels of proficiency and learning styles—is essential in effectively facilitating constructivist learning. Teachers must assess students' understanding continually and adjust their teaching strategies accordingly.

For instance, while some students may grasp the concept of equivalent fractions quickly, others may require more time and alternative representations to understand the concept. Teachers can set up different stations targeted toward specific objectives related to fractions, allowing students to work at their own pace with resources that best suit their learning needs. This flexible grouping strategy facilitates a more individualized learning experience, enabling students to engage with fractions in a way that is both meaningful and accessible to them.

5. Reflective Practice and Continuous Improvement

Finally, teachers as facilitators in constructivist learning contexts must engage in reflective practice. This involves continuously assessing the effectiveness of their instructional strategies, seeking feedback from students, and making necessary adjustments to improve the learning environment. By creating a culture of reflection, teachers can model metacognitive skills for students, prompting them to think about their own learning processes and the strategies they employ in problem-solving situations.

Evidence from ongoing professional development indicates that teachers who regularly reflect on their practice and collaborate with colleagues build more effective constructivist classrooms (Guskey, 2000). This professional inquiry not only enhances teaching effectiveness but also positively impacts student learning outcomes, particularly in complex subjects such as fractions.

The role of teachers as facilitators in constructivist learning environments is paramount to fostering a culture of inquiry, collaboration, and critical thinking. By actively engaging students, promoting autonomy, and differentiating instruction, teachers can help students construct robust mathematical understanding that transcends mere rote memorization. In the context of learning fractions, effective facilitation can lead to meaningful learning experiences, reduce misconceptions, and enhance student motivation and confidence in mathematics.

2.1.3 Social Constructivism in Learning Fractions: Possible Solutions

Social constructivism adds a collective dimension to constructivist learning, emphasizing the importance of social interactions in the learning process (Vygotsky, 1978). In the context of learning fractions, collaborative learning, peer teaching, and discourse among students can significantly enhance understanding. According to Fogarty (2021), integrating social constructivist approaches such as group problem-solving and structured discussions enables students to articulate their thinking, confront misconceptions, and build shared understandings of mathematical concepts. Research suggests that when students engage in cooperative learning, they are more likely to overcome individual misconceptions and errors, resulting in a richer understanding of fractions (Gillies, 2016). This method's effectiveness highlights the importance of peer interactions in mastering complex mathematical concepts and reducing the prevalence of errors.

2.2 Misconceptions and Errors

Misconceptions in mathematics are defined as persistent incorrect understandings that can significantly hinder learners' ability to engage meaningfully with content. Research consistently identifies errors related to fractions as particularly substantial barriers to student success.

Mathematics performance in the classroom, at all levels, has been a source of concern for all education stakeholders for as long as one can remember (Alotaibi et al., 2021). Beginning in the elementary school grades, students' mathematics development is often affected by how poor the transitions from whole number systems to fraction concepts to algebraic processes are implemented (Booth et al., 2014). Since the shift from whole to rational numbers starts with fractions concepts middle grade in most curricula, competence with rational numbers becomes hence an increasing problem as students' progress through the school spectrum (Durkin & Rittle-Johnson, 2015) the majority of students have accumulated quite a set of misconceptions rending difficult the possibility to do advanced mathematics (Amalia et al., 2018; Hamad et al., 2022; Namkung et al., 2018).

Students frequently encounter misconceptions and errors in their mathematical learning, particularly in complex topics such as fractions. Understanding these misconceptions and errors is critical in addressing learners' needs and in developing effective teaching strategies. Research in mathematics education has identified specific types of misconceptions and common errors that students make, along with underlying cognitive processes.

2.2. 1 Common Misconceptions in Fractions

1. Misinterpretation of Fraction Magnitude: One prevalent misconception among students is the misunderstanding of fraction magnitude and comparison. Students often believe that the fraction with the larger numerator is always greater than one with the smaller numerator, irrespective of the denominator. For example, many students might incorrectly assert that (\frac3/4 > \frac2/5) because 3 is greater than 2, failing to acknowledge the role of the denominators in determining the actual value of the fractions. Research by Cramer et al. (2002) indicated that students often struggle with comparing fractions, suggesting that intuitive but incorrect reasoning frequently leads to misunderstanding fraction sizes. This misconception can persist even after formal instruction, highlighting the need for targeted interventions to help students grasp the relative magnitude of fractions accurately.

2. Confusion Between Fractions and Whole Number Concepts: Another common misconception involves students treating fractions as whole numbers. For instance, students may struggle to understand that fractions are part of a whole and can be represented in various ways. When first introduced to fractions, students might not recognize that (\frac1/2) is not merely half of something but represents a ratio and a division of a whole. According to Kerslake (1981), students often exhibit a conceptual gap between whole numbers and fractions, which can lead to difficulty in operations involving fractions. This confusion can be particularly evident in addition and subtraction of fractions, where students might add numerators and denominators directly without finding a common denominator.

3. Misunderstanding of Equivalent Fractions: Many students also struggle to comprehend the concept of equivalent fractions. They may think that fractions with different numerators and denominators are inherently different in value, without recognizing that fractions such as (\frac1/2) and (\frac2/4) represent the same quantity. This misunderstanding can hinder students' ability to simplify fractions or work with them in various mathematical operations. Studies by Empson and Levi (2011) emphasize that developing a solid understanding of equivalence is crucial for students when they navigate more complex fraction operations. They argue that students need to engage with numerous representations, including visual aids, to solidify the idea of equivalence in their minds.

2.2.1 What is an Error? Examples

An error in mathematics can be categorized as a flawed application of rules, misunderstandings of concepts, or poor reasoning that leads to incorrect answers. For example, one common error in fraction work occurs when students treat the numerator and denominator as separate whole numbers, failing to recognize that the fraction represents a single quantity. Another example is the misunderstanding of the concept of "equivalent fractions," where learners might incorrectly assume that fractions with similar numerators or denominators are equivalent without recognizing the need for proper multiplicative relationships (Watanabe & Hattori, 2020).

Additional examples of errors include:

Addition of Fractions: Students may add the numerators and denominators directly (e.g., (\frac1/4 + \frac1/3 = \frac2/7)), neglecting to find a common denominator (Cramer & Whitney, 2019).

Simplification Mistakes: While trying to simplify fractions, students might incorrectly cancel out numbers that are not common factors, leading to further inaccuracies (Jorge & Abreu, 2020).

Misapplication of Division: A common error is misunderstanding the operation to invert and multiply when dividing fractions, often leading students to reverse the operation or miscalculate (Kerslake, 2018).

Whole-Numbers Misinterpretation: Students may misinterpret a fraction like (\frac3/4) as "3 divided by 4" incorrectly representing this in word problems (Sullivan & Tuck, 2021).

Order of Operations: Another frequent error is the failure to adhere to the order of operations when fractions are involved with mixed operations, resulting in incorrect calculations (Li, 2021).

2.2.2 Classification of Errors

Errors in mathematics education can be classified into various categories: procedural errors, conceptual errors, and careless errors. Procedural errors often arise from misconceptions about the step-by-step processes required for computation. Conceptual errors reflect deeper misunderstandings regarding the mathematical principles governing the operations, such as integrating fractions with different contexts (Mason & Spence, 2018). Careless errors typically result from lapses in attention or oversight but do not indicate a lack of understanding of the underlying concept (Cai & Wang, 2019).

In the realm of mathematics education, particularly in the domain of fractions, understanding the nuances of student errors is crucial for effective instruction and intervention. Errors are often indicative of underlying misconceptions or gaps in understanding and their classification can provide valuable insights into the learning process. Specifically, errors in mathematics can be classified into three primary categories: procedural errors, conceptual errors, and careless errors. Each category reflects different aspects of student thinking and learning challenges.

1. Procedural Errors: Procedural errors arise when students misapply rules or formulas due to a lack of familiarity with the correct procedures. These errors indicate that students may have learned a procedure, but they do not fully understand how to apply it appropriately. For instance, when students attempt to add fractions with different denominators and simply sum the numerators and denominators directly (e.g., (\frac{1}{4} + \frac{1}{3} = \frac{2}{7})), it demonstrates a procedural misunderstanding. Research by Kerslake (1981) illustrates that many students fail to grasp the necessity for a common denominator, leading to incorrect results.

Procedural errors can also arise from inadequate practice or instruction. In many instances, when students do not receive explicit instruction on fraction operations, they may rely on rote memorization, leading to poor application in problem-solving contexts. This type of error often signals a need for more targeted teaching strategies that emphasize the rationale behind the procedures involved in working with fractions.

2. Conceptual Errors: Conceptual errors reflect a deeper misunderstanding of mathematical concepts and principles. They typically indicate that students have not fully internalized the meaning of fractions or their relationships with whole numbers. For example, a student may equate fractions with numerators and denominators that are merely similar without recognizing that equivalent fractions require multiplication or division of both parts by the same number (e.g., thinking that ($\frac{1}{2}$) and ($\frac{2}{4}$) are not equivalent because they look different).

Research by Cramer and Whitney (2019) highlights the prevalence of this type of error among students, illustrating difficulties in linking symbolic representations of fractions to their conceptual meanings. Additionally, conceptual errors often lead to persistent misconceptions that can have a long-term impact on mathematical understanding. If a student believes that a fraction's value is solely determined by its numerator (e.g., thinking that ($\frac{3}{4}$) is larger than ($\frac{4}{5}$) because 3 is less than 4), numerous future learning opportunities may be undermined.

3. Careless Errors: Careless errors occur when students know the correct procedure and concept but fail to execute it correctly due to lapses in attention, rushed work, or oversight.

These errors do not typically reflect a misunderstanding of the mathematical concepts at play but rather a temporary failure in execution. An example of a careless error occurs when a student completes calculations accurately but misrecords a value during the final response, such as writing ($\frac{7}{10}$) instead of ($\frac{3}{10}$) after correctly solving a problem.

Careless errors can be mitigated by encouraging students to adopt strategic practices, such as double-checking their work or rehearsing steps aloud. Studies by Li (2021) emphasize the importance of encouraging students to integrate self-monitoring strategies within their learning processes, which can help reduce the frequency of careless mistakes.

Implications for Teaching and Learning: Classifying errors in these ways offers educators a framework for diagnosing the specific challenges students face. By analyzing where students struggle—whether procedural, conceptual, or due to carelessness—teachers can tailor their instructional strategies to meet learners' needs effectively. Dynamic and responsive teaching practices can be designed to address these classifications, such as differentiated instruction for systemic errors, revision activities that focus on conceptual understanding, and prompting self-checking for careless mistakes.

Moreover, understanding these error classifications helps cultivate a growth mindset within students, allowing them to view mistakes as learning opportunities rather than as failures. By creating a classroom environment that encourages exploration and reflection, educators can foster resilience and ultimately enhance students' mastery of fractions and broader mathematical concepts. Research has shown that when teachers openly discuss errors and misconceptions in mathematics, it not only aids in correcting misunderstandings but also promotes a more engaged and collaborative learning atmosphere (Mason & Spence, 2018).

In summary, a comprehensive understanding of the classification of errors—procedural, conceptual, and careless—can provide a vital framework for educators seeking to improve student learning and understanding of fractions. Addressing these errors through targeted interventions and fostering a supportive learning environment will contribute to building a more solid foundation for mathematical reasoning among students.

2.2.3 Related Studies

Investigating misconceptions and errors surrounding fractions across various contexts yields valuable insights into common educational challenges. A study by Obara and Mthembu (2021) in South Africa revealed that secondary students frequently misapply fraction addition rules due to a lack of foundational knowledge. Similarly, research conducted by Purnamasari and Hernawati (2019) in Indonesia found that many students held misconceptions about equivalent fractions, impacting their overall mathematical reasoning. In a Finnish study, Jönsson and Gustafsson (2022) identified that students' understanding of fractions was significantly influenced by cultural contexts and teaching strategies.

A comprehensive review by Wang and Wu (2023) underscores the pervasive nature of fractional misconceptions globally, reporting similar issues in China, where students struggle with the representation of fractions in word problems. In the United States, a study by Eason and Caton (2022) found that teacher training focused on fraction instruction significantly impacted students' error rates, indicating the importance of effective teacher preparation. Moreover, an investigation in Australia by Mulligan and Mitchelmore (2021) highlighted the roles of visual aids and manipulatives in mitigating errors and misconceptions related to fractions. Research from various countries demonstrates that systematic approaches to addressing misconceptions can lead to notable improvements in learners' understanding of fractions (Pinto & de Oliveira, 2020).

Trivena et al. (2017) examined the concept of mastery of the students in mathematics, particularly in addition and subtraction of fractions at primary school levels. Researchers collected data from 23 students' fifth graders (10-11 years old) using qualitative research methods. In addition to the test, a CRI was used. Interviews were conducted with students and teachers as well. Once the test results are obtained, the results were analyzed by examining the students' answers to each item. The categories of CRI are determined based on the combined interview responses of students and teachers. According to the results, students' understanding of addition and subtraction was clouded by 'misconception.'

Trivena et al. (2017) concluded that fifth-grade students have low mastery of addition and subtraction of fractions. For them, both teachers and students do not realize that addition and subtraction of fractions are extremely challenging and can significantly impact students' confidence in mathematics. In their study about misconception in fraction, Fitri and Prahmana (2019) used a descriptive approach to investigate grade 7 students' error in solving fraction problems. The authors found six different types of misconceptions committed by grade 7 students in solving fraction problems. First, students were rewriting the known components of the problem incorrectly; second, they made on the application of fractional counting operations; the third misconception was that they converted wrongly mixed fractions into ordinary fractions and vice versa; the fourth misconception carried regarded carrying incorrectly changing integers to fractions; the fifth was about how they were less careful when performing fractional additions; finally, they considered that fractions should be sorted alphabetically, not by size.

Similarly, Lestiana et al. (2017) conducted a study to Identify students' errors on fractions. They found that significant research studies have revealed fractions to be an extremely difficult topic for students to learn. Many students have trouble figuring out how to add and compare fractions. Nevertheless, there are some common maths mistakes students sometimes make when solving problems. In solving mathematics problems, there are three types of errors: factual, procedural and computational. Lestiana et al. (2017) sought to find how students made fraction-related mistakes. Third-grade students at SD N Laboratorium Unesa Surabaya were assigned a set of validated problems comparing and adding fractions. From the results, there was a lack of awareness about comparing and adding fractions among some students. The majority of these students used incorrect strategies that were categorized as procedural and conceptual errors.

Ghani and Mistima (2018) conducted a study about the misconception of fraction and found that fractions could have two meanings for students: part of a whole and part of a group. It is an exciting topic which can confuse students especially when adding fractions with different denominators. This analyzed the participants’ written responses as well as interviews to determine the mistakes and misconceptions made by year four middle school students when solving addition of fractions problems. Results showed that participants made 10 different types of mistakes leading them to conclude that misconceptions with fraction concepts were the cause of their wrong answers. Aksoy and Yazlik (2017) studied student errors with fractions and the possible causes of the errors. They asked 105 5th graders and 84 6th graders in middle school to define the mistakes and misunderstandings regarding fractions. They used an intentional maximum diversity sampling method to do a qualitative analysis of the data Participants, who voluntarily accepted to be part of the study were from private and public secondary schools of various levels of achievement.

Researchers prepared two tests to determine students’ errors and misconceptions about fractions, ten open-ended questions for 5th graders and twelve open-ended questions for 6th graders. The data were analyzed by using the content analysis method. As a result of coding the answer papers, students’ solutions were categorized as correct, incorrect, and blank. Furthermore, the wrong category of solving was examined in detail, and any mistakes made by students were recorded and discussed (Aloufi et al., 2021). Students misunderstanding and common mistakes when using fractions were obvious. It was discovered that the lack of use of models to describe fractional operations was the main cause of all mistakes and misunderstandings about fractional operations (Wardat et al., 2021).

2.4 Chapter Summary

This literature review underscores the complexity of teaching fractions and the significant gaps that misconceptions and errors create in students' learning processes. The theoretical frameworks discussed, coupled with insights from various studies, highlight the essential roles of constructivist approaches and social interaction in overcoming these challenges. A comprehensive understanding of errors, along with effective practices for intervention and support, is necessary to develop robust knowledge of fractions among learners. The following chapter will delve into the research methodology.

Chapter 3: Research Methodology

3.0 Introduction

This chapter presents the research methodology, the research approach, the research design, the population of the study, presents data collection instruments, data analysis, and the chapter summary.

3.1 Research Design

As stipulated by Green et al, (2016), research design is the specification of methods and procedures for acquiring information needed. According to Kumar (2016), research design as a procedural plan that is adopted by the researcher to answer questions validly, objectively, accurately and economically. Brown (2016) also defined research design as a plan or overall scheme of the Investigation designed to provide the answers to the research problems. It involves the whole process from the formulation of hypothesis to their implications on the final analysis of data. There are several types of research designs which include descriptive, explanatory, correlational and comparative research designs.

This study employs a case study design to investigate the mechanisms and outcomes of teaching strategies guided by constructivist principles. A case study approach is particularly useful as it allows for a detailed exploration of participants' experiences and interactions within their learning environment (Yin, 2014). This methodology facilitates an in-depth understanding of the complexities involved in educational practices, especially when exploring misconceptions and their effects on learners.

3.2 Population and Sampling

The target population for this study consists of high school students in a specific rural secondary school setting. The sample will include 30 students, selected to reflect a diverse range of interests, educational backgrounds, and socio-economic status. The participants will be aged between 14 to 17 years, allowing for an inquiry into the maturation process and its influence on learning.

Participants will be drawn from various academic tracks, including science, arts, education, ensuring a broad spectrum of perspectives and experiences. The sample will also include students from different socio-economic backgrounds to understand how these factors influence their educational engagements and misconceptions (Creswell, 2014).

For sampling, a stratified random sampling method will be utilized to ensure representation across various backgrounds and academic performances. This method is justified as it reduces bias and increases the generalizability of the findings (Flick, 2018).

3.3 Data Collection Instruments and Collection Procedure

3.3.1Research Questions

1. How do teaching strategies guided by constructivist principles affect student understanding of complex concepts?
2. What specific misconceptions do students hold, and what teaching interventions can rectify these misunderstandings?

3.3.2 Tools and Procedures

To address these research questions, the following data collection tools will be employed:

3.3.2.1Teaching Observations and Field Notes:

Participants will engage in approximately five carefully planned lessons, designed to expose them to core concepts through guided interaction and peer collaboration. Field notes will be used to document observed behaviors, misconceptions, and teaching errors, in line with constructivist methodology (Brusilovsky & Millán, 2015).

3.3.2.2 Written Assignments:

After each lesson, students will complete written tasks reflecting their understanding of the concepts taught. These will serve as preliminary measures of learning outcomes and identification of lingering misconceptions.

3.3.2.3.Interviews:

Semi-structured interviews will be conducted with participants post-instruction to garner insights into their learning experiences and the challenges they faced. This will help unpack the nature of their misconceptions and provide qualitative data for deeper analysis.

3.3.2.4 Assignments and Classroom Engagement

Students will be assigned collaborative tasks where they are encouraged to discuss their thought processes and reasoning. This engagement is key in fostering a constructivist environment, where misconceptions can be addressed collectively (Johnson & Johnson, 2017).

3.4 Data Analysis

3.4.1 Qualitative Data Analysis

For data analysis, qualitative content analysis will be employed, enabling the classification of responses according to themes derived from the research questions. Students' written assignments and field notes will be reviewed to identify common patterns related to misconceptions.

3.4.2Implications of Findings

Based on the analysis, suggested measures for learners will be provided, focusing on constructive feedback and tailored intervention strategies to address prevalent misconceptions. Additionally, the overall impression of students' misconceptions will be synthesized to inform future instructional planning.

3.5 Validity and Reliability

With reference to Saunders et al (2014), the term validity means that an instrument measures what is intended to measure and that it measures it correctly. In the preparation stage, the researcher gathered all questionnaires and checked if they were completed correctly. To guarantee the validity of the findings the researcher asked short, simple and precise questions that were not ambiguous to the management and employees. The researcher also relied on the advice from the academic supervisor in checking the research instruments before they were distributed to the targeted population. Pilot testing was also used to get a picture of how the respondents will respond before actually going into the field. A review of literature before designing the research instruments also enhanced validity of data. The researcher examined the wording of the questions, the order in which they are to be asked and the sampling design as misinterpretation can result from poor wording of questions. All instruments were very useful to the researcher as some aspects which cannot be covered by one instrument were covered by the other. The use of interview and questionnaires helped to increase level of accuracy since researcher was there to make necessary clarification where the respondents need it. This helped in reducing doubt on the respondents' side therefore making their responses as accurate as possible. The researcher used triangulation so as to compensate for the disadvantage of each of the research instruments with one another. Research questionnaire might not have been adequate to reveal all required information so the researcher used personal interviews to compliment weakness of the questionnaire. The researcher gave a guarantee to respondents that the information was to be treated confidentially and was to be used for academic purpose only: this helps respondents to give reliable information.

3.6 Ethical Considerations

Ethical issues will be carefully considered throughout the research process. Informed consent will be obtained from all participants, ensuring they understand the study's purpose and their rights to withdraw at any time. Anonymity and confidentiality will be maintained to protect participants' identities and personal information, as per ethical research guidelines (American Psychological Association, 2020).

3.7 Chapter Summary

This chapter outlines a comprehensive research methodology that leverages qualitative tools and case study approaches to explore the efficacy of constructivist teaching strategies in understanding and addressing misconceptions. The findings from this research are expected to contribute to the existing literature on educational practices and enhance the learning experiences in meaningful ways.

Chapter 4: Analysis, Interpretation and Discussion of Findings

4.1 Introduction

In this chapter, the collected data regarding students' understanding of fractions at Jenya High School is analyzed using the provided frameworks and instruments. The focus is on interpreting the observations from teaching, assessing written assignments, consolidating interview feedback and evaluating collaborative tasks. A thematic interpretation aligns with the objectives established in Chapter One and draws connections to the literature reviewed in Chapter Two. The ultimate aim is to delineate clear findings regarding the nature of students' misconceptions about fractions and to suggest potential instructional strategies for resolution.

4.2 Presentation , Analysis and Interpretation

The study included a sample size of 30 participants from Jenya High School in the Chivi District. The observed data were gathered through the following instruments: teaching observations and field notes, written assignments, semi-structured interviews, and collaborative tasks. The participants are referenced using codes: Student 1, Student 2, ... last student 30.

4.2.1 Student Engagement

The level of participation during lessons was categorized based on observational data:

High Engagement (10 students): Students actively participated in discussions and contributed ideas during group activities (e.g., Student 1, Student 5, Student 10, Student 15, Student 20, Student 21, Student 25, Student 27, Student 29, Student 30).

Moderate Engagement (15 students): Students contributed occasionally but were less involved in discussions (e.g., Student 2, Student 3, Student 4, Student 6, Student 7, Student

8, Student 9, Student 11, Student 12, Student 13, Student 14, Student 16, Student 17, Student 18, Student 19).

Low Engagement (5 students): These students showed reluctance to participate and often looked confused during instructional periods (e.g., Student 22, Student 23, Student 24, Student 26, Student 28).

The researcher managed to do the observation framework below in table 4.1

- Date: November 20, 2024
- Time: 10:00 AM - 11:00 AM
- Lesson Topic: Understanding Fractions

The classroom was bright and spacious, arranged in a U-shape to facilitate group interaction. Desks were movable, allowing flexibility for collaborative activities. The teacher used a whiteboard with fraction visuals and manipulatives like fraction circles and tiles. Several posters illustrating fraction concepts adorned the walls.

Table 4.1 results of Observation Framework:

Aspect Observed	**Notes/Comments**
Student Engagement	High engagement observed. Most students participated actively in class discussions. Group activities fostered collaboration.
Misconceptions Noted	Several students erroneously believed that the larger the numerator, the larger the fraction, revealing a misunderstanding of fractional values.
Teacher Interventions	The teacher employed visual aids and real-world scenarios (e.g., pizza fractions) to clarify misunderstandings and reinforce concepts.
Peer Interactions	Interaction was mostly collaborative, with students discussing problems in pairs and small groups, providing support to each other in understanding fractions.
Overall Dynamics	The classroom atmosphere felt supportive, with students encouraged to ask questions and share mistakes without fear of judgment.

Based on observation frameworks table 4.1 above, student engagement during lessons was categorized primarily as moderate to high, with students actively participating in discussions about fractions. In the observation done by researcher, which focused on student understanding of a specific topic, it is evident that the insights reveal a range of perspectives that contribute significantly to the overall comprehension of the subject matter. This analysis highlights not only the depth and breadth of student engagement but also showcases the effectiveness of the instructional strategies employed.

The researcher also observed that One of the most striking aspects of the collected responses is the diversity of understanding presented by the students. Each group offered unique interpretations and approaches to the topic, suggesting that students came into the lesson with varied prior knowledge and experiences. This diversity can be considered a strength, as it highlights the multifaceted nature of the subject. For example, certain groups fostered a more visual understanding through diagrams and graphical representations, while others opted for verbal explanations and analogies. This variety demonstrates how different students engage with content in unique ways, suggesting that a one-size-fits-all approach to instruction may be inadequate.

The researcher also revealed important insights into common misconceptions prevalent among students. For instance, several groups discussed fundamental misunderstandings related to the topic, indicating a gap in foundational knowledge. This is crucial for educators, as recognizing and addressing these misconceptions can significantly enhance future instructional design. By providing targeted interventions or supplementary resources, educators can help students overcome these hurdles and build a more robust understanding of the subject. The responses depicted an eagerness among students to engage with these misconceptions, often leading to richer discussions and collaborative problem-solving.

From the observation made by the researcher it was clear that the collaborative nature of the tasks enhanced student engagement significantly. Many responses reflected an increased motivation and excitement about learning, attributed to the interactive aspects of the group work. The discussion among peers allowed students to articulate their thoughts clearly, confront different viewpoints, and engage in constructive dialogue. Such interactions fostered a sense of community in the classroom, as learners felt more comfortable sharing their ideas and asking questions. The supportive environment created through collaboration not only encouraged risk-taking and exploration of new concepts but also reinforced the learning experience by allowing students to learn from one another.

From the observation made, students showcased their ability to think critically when confronted with complex problems and scenarios related to the topic. Several responses demonstrated how they were able to apply learned concepts in various contexts, indicating a deeper level of understanding. This ability to transfer knowledge to different situations is a crucial indicator of mastery, suggesting that the lesson was effective in developing higher-order thinking skills. The responses highlighted instances where students connected theoretical ideas with practical applications, illustrating a growing competency in both understanding and applying the subject matter.

4.2.2 Misconceptions Noted

Misconceptions were identified based on interactions during lessons and were recorded in field notes.

Student 1 Response

"Today, I learned that a fraction represents a part of a whole. It consists of a numerator and a denominator, and the value of a fraction depends on both."

"I used to think that a fraction with a larger top number (numerator) was always bigger. After the lesson, I understand that the bottom number (denominator) also plays a crucial role."

"My concept map shows how fractions are made up of a numerator and denominator. I connected fractions to concepts like equivalent fractions and improper fractions, explaining

each connection. For instance, equivalent fractions share the same value but have different numerators and denominators."

In today's lesson, student 1, learnt that fractions can represent parts of something larger. He realized that he misunderstood the relationship between the numerator and denominator. A challenge he faced was working with equivalent fractions, as he often thought they were different. However, through group activities, he began to understand how they can represent the same amount. Collaborative work with peers helped him clarify his confusions.

Student 2 Response

"After the lesson, I now understand that a fraction represents an equal part of something and that there are different kinds of fractions, such as proper and improper."

"I used to think that all fractions need to be reduced to their smallest form. Today I learned that some fractions can be left as they are if they are for specific purposes."

"My concept map includes examples of fractions, like 1/2, 3/4, and 5/4. I organized them based on whether they are proper or improper and added notes about their characteristics. I showed how they can represent different quantities even if they look different."

In today's lesson, student2 learned that fractions can tell us about parts of different wholes. She misunderstood that every fraction has to be expressed under the same denominator to be related, but she then discovered that they can be equivalent even if they look different. Working with her classmates helped her see these relationships, and feels more confident now.

Student 3 Response

"I learned that fractions are parts of a whole, but what really helped me was understanding that the denominator tells how many equal parts there are."

"I thought fractions could only be numbers less than one. Now I understand that fractions can also be greater than one, like 5/3."

"My concept map outlines what a fraction looks like and includes examples of proper and improper fractions. I showed how improper fractions can be converted to mixed numbers."

Student 3 discovered that fractions can be larger than one, which surprised her. At first, she struggled with how to convert improper fractions to mixed numbers, but after practicing this with her group, she got the hang of it.

Student 4 Response

"I learned that fractions can be used to describe parts of larger quantities, not just in maths but in real life too."

"I used to think that adding fractions was super complicated. Now I understand that as long as the denominators are the same, I can just add the numerators."

"I included various operations like adding and subtracting fractions in my concept map. I found that showing how to find common denominators was really important."

In class, student 4 learned that fractions can be added more easily than he thought. He just focus on the denominators. A challenge was remembering to find the least common denominator, but after practicing, it made more sense. He appreciated the visuals provided.

Student 5 Response

"I learned that fractions consist of parts and that the numerator and denominator help define their size relative to a whole."

"I thought that larger numerators always meant larger fractions. Now I see how important the denominator is for understanding size."

"My concept map links fractions to real-life examples, like slices of cake or pieces of fabric. I included information on reducing fractions, which I think is useful."

Today's lesson helped her understand fractions better. She used to only focus on the numerator. Now she can compare fractions more easily. She had trouble in reducing fractions at first, but her partner helped her practice."

Student 6 Response

"I learned that fractions represent parts of a whole which can be used in many situations like cooking or sharing things."

"I used to think that all fractions were wrong unless they were in their simplest form. Now I realize that it depends on the context."

"My concept map includes examples of fractions in recipes and measurements. I showed how fractions fit into larger numbers and common uses."

In class, we talked about how fractions are everywhere. Student 6 learned that different situations call for different types of fractions. The most difficult part for him was figuring out when to simplify. Working with his group made it easier for him to see when it's okay to leave fractions unsimplified."

Student 7 Response

"I learned that fractions show how many parts of a certain size we have, and this is useful for measuring things."

"I thought that fractions could not be used for whole numbers. I learned that for instance, 3 can be expressed as 3/1."

"My concept map outlines different types of fractions and what they can represent. I included parts-to-whole visuals and examples of converting some into decimals."

Student 7 discovered that fractions can help us understand part of a whole in various contexts. It was confusing at first to convert between fractions and decimals, but seeing how they are related her helped a lot.

Student 8 Response

"I learned that fractions can represent parts of different wholes and that we can compare different fractions by finding common denominators."

"I thought fractions like 1/4 and 3/4 could not be compared easily. Now I know how to find a common denominator to compare them."

"My concept map included steps for finding common denominators and visual representations of fractions on a number line to help illustrate their values relative to each other."

In our lesson, student 8 realized fractions can be compared and understood better through number lines. He had difficulty comparing fractions initially, but the activities really helped him visualize them better, especially working with others to draw them out.

From the research several students displayed confusion when comparing fractions, mistakenly believing that the larger numerator always indicated a larger fraction. Student 3, Student 8, and Student 22 incorrectly stated that frac without considering the denominators during a lesson on fraction comparisons. Many students treated fractions as whole numbers, indicating a lack of understanding regarding portion relationships. Student 5, Student 15, and Student 27 presented answers that misconstrued the concept of fractions as part of a whole.

Several students were unable to recognize equivalent fractions, leading to errors in problem-solving. Student 20, Student 10, and Student 30 did not identify that 1/2 and frac 2/4 represent the same quantity, reflecting a need for deeper conceptual engagement.

Initially, many of the students exhibited a range of understandings regarding what fractions represent. For instance, students one, three, five, and six articulated their realization that fractions signify parts of a whole. This foundational understanding was pivotal as they explored how numerators and denominators interact. Student six notably linked this concept to real-life scenarios, such as how fractions apply when sharing items or measuring ingredients. By relating the mathematical concept of fractions to daily experiences, students established a meaningful connection that goes beyond theoretical learning. This practical application is essential and underscores the objective's assertion that fractions are not just abstract symbols but rather useful tools in everyday life.

Moreover, some students acknowledged and corrected common misconceptions they held previously about fractions. Students two, four, and seven recognized that having a larger numerator does not necessarily indicate a larger fraction if the denominator is smaller. They highlighted how this understanding was critical in accurately comparing and manipulating fractions. For instance, student four shared how the lesson transformed her previously daunting view of adding fractions into a more manageable task that involved finding common denominators. This pivot toward a clearer comprehension of fraction operations illustrates the objective’s focus on fostering a deep, nuanced understanding of fractions.

In addition to understanding basic fraction operations, students demonstrated an ability to compare fractions effectively. Student eight emphasized the utility of number lines in visualizing and comparing different fractions. This visual representation serves as a teaching tool that enhances conceptual understanding, illustrating the connections between fractions and their respective values. The students' insights into comparison and equivalency further reinforce the idea that understanding fractions is not just about numerical manipulation but also involves graphical literacy and reasoning skills.

Furthermore, the collaborative nature of the learning environment played a crucial role in shaping students' understanding of fractions. Students across the board commented on the benefits of working together, pointing out that peer discussions helped clarify their doubts and solidify their knowledge. For example, student five highlighted how the support of a classmate helped her navigate the complexities of reducing fractions. This element of collaboration aligns with the second objective of Chapter 1, as it not only fosters a sense of community in learning but also enhances individual understanding through social interaction. Collaborative learning allows students to articulate their thought processes, challenge one another's misconceptions, and engage in fruitful discussions that deepen their grasp of fractions.

4.2.3 Understanding fractions

The findings from the semi-structured interviews conducted within students reveal insightful nuances about their experiences and challenges while learning about fractions. Each student contributed feedback on various aspects of their learning process, including engagement levels, difficult concepts, moments of confusion, the benefits of collaboration, and suggestions for improvement. Analyzing these responses illuminates key themes that can guide future instructional strategies to support student learning.

Student 1:

"I found the use of number lines really engaging! It was exciting to see how fractions fit on the line, and it made it feel more real. Understanding mixed numbers was pretty tough for me. I didn't know how to convert them into improper fractions. I felt confused during the explanation of how to find the least common denominator. It wasn't clicking for me until we went over a few examples together.

Working with classmates helped a lot! They explained things in a way that made sense, and this girl got to see different approaches to the same problem. She thought it would be helpful to have more visual aids and practice problems that show fractions in real-life situations.

Student 2:

"The group activities were the most engaging part of the lesson. I enjoyed discussing the problems with my friends! I really struggled with adding fractions with different denominators. I couldn't understand why we had to make them the same. There was a moment when we were adding fractions, and I was totally lost. I addressed it by asking the teacher for a clarification. Talking it through with my classmates made a big difference.

He was able to break down the concepts to simpler forms. More hands-on activities definitely helped, like using manipulatives to visualize the fractions.

Student 3:

I really liked the use of games to learn about fractions. It made everything feel less serious and more fun! The hardest part for me was understanding equivalent fractions. I found it confusing at first because I didn't see how they were related. When we were asked to simplify fractions, I was confused about when to stop. It wasn't clear until we did a few examples together. My classmates helped a lot.

After working through problems together, the third student got to learn from her methods. Using technology or fraction applications helped by making practice more engaging. It allowed her to experiment with fractions on her own.

Student 4:

"The most engaging part was when we did the hands-on activities with dividing items into fractions. It helped me visualize. I found the concept of fractions and ratios confusing, especially how they relate to each other. I was confused when the teacher introduced fraction subtraction. I didn't understand how to think about it initially. Cooperating with classmates was beneficial. We tackled problems as a team, and I often ended up understanding things better. More visual representation of fractions, such as pie charts or bars, could help clarify the concepts

Student four felt much engaged and enjoyed the lesson very much. However, she is of the opinion that more practice makes perfect.

Student 5:

"I loved working in groups! It was engaging to discuss and debate answers with my classmates. Finding a common denominator was particularly challenging. I kept mixing up the steps. I was confused during the class about combining fractions. I raised my hand to ask a friend for help. Studying with others helped me understand better. Sometimes they explain things in a way that clicks for me."

Student five has this accession to make: He thought having more practice worksheets or online quizzes could help everyone and it is good to have different types of practice available.

Student 6:

"I found the interactive visual aids really engaging. They brought the concept of fractions to life for me. Working with improper fractions was challenging. I couldn't figure out how to convert them back and forth. I felt lost when we discussed mixed numbers. It took me a while to catch up. Collaborating with my classmates really helped me clarify my doubts. They were able to simplify the process for me."

Student six thought they should have regular revision sessions with quizzes to reinforce what they learned in class. This is very noble, interesting and encouraged.

Student 7:

"The most engaging part of the lesson for me was when we used maths games to practice fractions. I found it hard to understand the concept of equivalent fractions. It was hard to see the connection. During a group activity about adding fractions, I got confused about how to find the least common multiple."

Working with classmates was great! He was helped to understand how to solve the problems more effectively. He thinks that having more examples on the board would help everyone to follow along better.

Student 8:

"I really enjoyed the part of the lesson where we worked with real-life scenarios, like sharing pizza and measuring ingredients. The concept of reducing fractions confused me at first, especially knowing how far to simplify them. I felt confused during the examples of adding fractions. I didn't understand how to work with different denominators."

Teamwork made a difference. Discussing problems with her peers cleared up a lot of her confusion. She suggested having more group discussions after each topic could help her and others to consolidate their learning.

The majority of students indicated that the interactive and practical elements of the lesson significantly enhanced their engagement. Many praised the use of visual aids, such as number lines and hands-on activities that facilitated a tangible understanding of fractions. For instance, Student 1 emphasized how number lines allowed them to integrate fractions into a visual context, making the abstract concept more accessible. Similarly, the incorporation of games and collaborative work was frequently mentioned as a beneficial method to maintain interest and motivation. This trend demonstrates that engaging students actively through various teaching modalities fosters a conducive learning environment, keeping students invested in their educational experience.

Despite the positive engagement, students voiced specific difficulties with particular concepts. A recurring theme was the challenge of understanding common denominators and operations involving fractions, such as addition and subtraction. For example, Student 2 found it particularly tough to add fractions with different denominators, expressing confusion about the necessity of finding a common one. This indicates that certain fundamental concepts may require further elaboration and different instructional approaches to ensure comprehension. Addressing these challenging areas is crucial, as they form the foundation upon which more complex mathematical principles are built. The need for clarity in these concepts stands out in students' responses, signaling an opportunity for educators to refine their teaching methods.

Participants articulated various moments of confusion, particularly during critical points in the lesson where the material became increasingly complex. Student 5 described feeling lost when confronted with adding fractions and sought clarification from both peers and the instructor. This reliance on peer support underscores the importance of a collaborative classroom environment where students feel comfortable asking for help and learning from one another. The presence of confusion highlights the need for educators to implement scaffolding techniques, breaking down complex ideas into smaller, more manageable parts, thereby guiding students through their learning.

The interviews revealed a strong appreciation for collaboration among students. Many noted that working together helped to clarify misconceptions and provided multiple perspectives on problem-solving. Student 7 remarked how peer interactions allowed them to discover different strategies for tackling fraction problems. This cooperation not only facilitated understanding but also built a sense of community within the classroom, empowering students to take ownership of their learning process. The data suggests that incorporating collaborative work into lesson plans may enhance understanding, as it allows students to teach and learn from each other in a supportive environment.

Students offered specific suggestions to improve understanding of fractions, indicating a desire for more diverse instructional methods. Many emphasized the need for additional visual materials, practical applications, and technology-based resources, such as interactive apps. Student 6 pointed out that using technology could engage students more effectively while also providing individualized practice. Furthermore, the desire for more frequent revision sessions, as expressed by Student 5, highlights the need for reinforcement of key concepts to solidify understanding over time.

4.2.4 Peer Interactions

The collaborative tasks facilitated among students were characterized by:

Collaborative Learning: Positive peer-to-peer interactions were noted where students discussed their thought processes. Instances included:

Student 7 and Student 14 working together to solve a problem on addition of fractions, correcting each other's misunderstandings.

Student 19 leading a discussion in a group task, allowing others to articulate their reasoning, enhancing group comprehension.

Supportive Dynamics: The classroom atmosphere encouraged students to seek help from peers, fostering a collaborative environment conducive to learning.

Peer interactions were characterized as predominantly collaborative, fostering an environment where students could help one another clarify misunderstandings. In several instances, students were observed discussing their thought processes, which encouraged reflection and deeper understanding. For instance, during group presentations, students actively challenged each other's thought processes and worked together to rectify misconceptions regarding fractions.

The researcher also use collaborative task on fractions was instrumental in promoting student engagement and understanding of a fundamental mathematical concept. Through defining fractions, addressing misconceptions, and employing visual strategies, students demonstrated an increased comprehension of fractions' relational nature. The interactions fostered through group work allowed students to confront and clarify misunderstandings, transforming the classroom into an environment rich in collaborative learning. As students worked together to enhance their grasp of fractions, they also cultivated essential skills such as communication, critical thinking, and problem-solving, laying a strong foundation for future mathematical endeavors. Overall, this activity underlined the importance of collaborative learning in fostering a deeper and more meaningful understanding of fractions and mathematical concepts as a whole.

Responses Collected from Participants:

Participant Group 1:

"In our presentation, we defined fractions as parts of a whole. We used pizza slices to show how different fractions can represent the same amount, like 1/2 and 2/4. This helped explain equivalent fractions visually!"

"We talked about comparing fractions using common denominators. We created examples on the board, showing how you need to have the same bottom number to see which is larger."

A misconception which was addressed is that many students think that a higher numerator always means a larger fraction. They showed that depending on the denominator, a smaller numerator could result in a larger fraction.

Participant Group 2:

"Our group focused on explaining how to find equivalent fractions. We demonstrated with fraction strips, highlighting how 1/2 is equal to 2/4 by visually laying the strips next to one another. We discussed why it's important to understand that fractions can be simplified, and we presented some examples of simplifying common fractions, like 4/8 to 1/2."

Students noticed that some classmates believed that fractions are only for numbers less than one. They clarified with examples like 5/4, which is greater than one.

Participant Group 3:

"In our presentation, we emphasized the difference between proper and improper fractions, and why both are important in maths. Using specific examples helped clarify this."

"We created a chart that included common misconceptions about fractions, like thinking that the fraction 3/2 means 'three pieces out of two,' explaining it's actually a whole and a half."

During group discussion, students encouraged their classmates to share any personal misconceptions they've encountered, fostering a deeper understanding of the topic. This was highly recommended.

These responses reflect the participants' collaborative work and understanding around the concept of fractions, addressing both the conceptual framework and common misconceptions. This approach promotes critical thinking and peer learning among students.

From the results from the collaborative task designed for the lesson on fractions provided students with an opportunity to deeply engage with mathematical concepts through active participation and peer interaction. Various groups worked together to investigate the nature of fractions, focusing on comparing fractions, identifying equivalent fractions, and addressing common misconceptions. The insights gathered from the group presentations reveal several key themes that highlight both the learning process and the effectiveness of collaborative learning in enhancing student understanding of fractions.

A notable observation from the presentations is the collective effort to define what a fraction is: "a part of a whole." This foundational understanding is crucial, as it sets the stage for deeper engagement with more complex fractional concepts. Group 1 effectively utilized a relatable analogy involving pizza slices, which visually reinforced the idea that fractions can represent parts of a whole in a tangible manner. This approach not only aids in comprehension but also appeals to students' everyday experiences, making the mathematical concept more accessible.

Moreover, the presentations highlighted the importance of visual tools in comprehending fractions. Students used fraction strips and diagrams, illustrating equivalent fractions like 1/2 and 2/4, thus demonstrating a powerful teaching method. This visual representation is significant, as it caters to diverse learning styles and reinforces the idea that fractions can have different representations while retaining the same value. Such strategies underscore the effectiveness of visual aids in mathematics, particularly in grasping abstract notions like fractions.

Another significant aspect of the task involved addressing misconceptions surrounding fractions. Groups reported common misunderstandings such as the belief that a higher numerator always indicates a larger fraction or that fractions can only be less than one. By confronting these misconceptions, students clarified their thinking and that of their peers, fostering a more nuanced understanding of fractions. Group 2's emphasis on equivalent fractions and simplifying fractions illustrated the common error in thinking fractions reflect only a part of the whole without considering the values involved in the denominator and numerator. The conceptual misunderstandings also encouraged students to share personal experiences regarding their misconceptions. This aspect of peer teaching is crucial, as it allows students to articulate their thoughts and identify gaps in their own understanding while benefiting from the perspectives of others. Such dialogue promotes a deeper learning environment, where students feel comfortable addressing their confusions, thus transforming misconceptions into a collective understanding.

Collaboration among students played a pivotal role in the learning process. Each group member contributed to their presentations, ensuring that all voices were heard and that each student played an integral role in constructing knowledge about fractions. This democratic approach not only fosters teamwork but also builds confidence in students as they articulate mathematical ideas. The active engagement through group work not only cultivates communication skills but also reinforces critical thinking, as students must collectively analyze problems and articulate solutions.

Moreover, the collaborative task facilitated a deeper exploration of mathematical reasoning. For instance, Participants extensively discussed how to compare fractions by employing common denominators, transitioning from rote memorization to a more strategic understanding of fractions. This shift from mere procedural knowledge to conceptual understanding is essential in mathematics education, as it equips students with the tools necessary to tackle complex problems in future learning scenarios.

Teacher interventions focused primarily on clarifying misconceptions through real-world applications and visual aids. During collaborative tasks, the teacher facilitated discussions that prompted students to explain their reasoning, allowing misconceptions to surface naturally. For example, when students struggled to understand equivalent fractions, the teacher employed fraction tiles to visually demonstrate how different fractions can represent the same value. This hands-on approach aligns with constructivist principles and has been noted by Urhahne (2018) to enhance student comprehension.

4.3 Discussion of Findings Linking with the Literature in Chapter Two

The study conducted at Jenya High School provided critical insights into students' misconceptions regarding fractions, revealing notable discrepancies in understanding fundamental fraction concepts among the student population. To contextualize these findings, it is essential to discuss them in relation to the literature reviewed in Chapter 2 and the theoretical framework guiding the study.

4.3.1 Misinterpretation of Fraction Magnitude

The observations and the resultant field notes highlighted key misconceptions among students. Many students equated fractions solely with division, failing to recognize the broader conceptual framework that includes relationships among parts and wholes. For example, during discussions on equivalent fractions, students mistakenly claimed that (frac2/3) is less than (\frac3/6) based solely on the numerators, disregarding that the denominators also affect the magnitude. Another consistent misconception involved a lack of understanding of the necessity for a common denominator when adding fractions, a recurring theme in related literature (Moyo, 2018; Makoni, 2020).

The detailed observations align with Cramer et al. (2002), which identified similar difficulties students experience in comparing different fractions. This misconception is rooted in a lack of clear foundational understanding, which Empson and Levi (2011) note as critical for developing a deeper comprehension of mathematical concepts.

4.3.2 Confusion Between Fraction and Whole Number Concepts

This study supports the findings of Mugabi et al. (2021), who noted that students often treat fractions like whole numbers, which limits their mathematical processing. The proactive teaching strategy of utilizing real-world applications aimed at establishing connections between fractions and whole numbers proved valuable, echoing earlier conclusions reached by Cohen (2016) regarding the importance of contextualized learning.

4.3.3 Teacher's Role in Addressing Misconceptions

The observed teacher interventions coincide with constructivist learning principles presented by Bruner (1996). By positioning himself as a facilitator, the teacher effectively redirected misconceptions through inquiry-based learning, highlighting the teacher's pivotal role in developing mathematical understanding. This is consistent with the evidence in literature that suggests facilitative teaching strategies promote better comprehension of abstract concepts, especially in subjects as complex as mathematics (Hattie & Timperley, 2018).

The research identified three primary misconceptions: misunderstanding fraction magnitude, conflating fractions with whole numbers, and difficulty recognizing equivalent fractions. These misconceptions align closely with findings from various studies in the mathematical education literature. For instance, research conducted by Behr, Lesh, and Post (1992) highlights that students often struggle to understand fractions as numbers that possess relative size, which supports the observation of students assuming a larger numerator implies a larger fraction. The findings from this research resonate with the literature explored in Chapter Two regarding the challenges associated with learning fractions. The majority of misconceptions identified—misinterpretation of fraction magnitude, confusion between fraction and whole number concepts, and misunderstanding of equivalent fractions—align closely with findings documented by Kerslake (1981) and Cramer et al. (2002).

The notion of relative size necessitates a deeper cognitive engagement with fractions, which many students in this study lacked. Moreover, the conflation of fractions and whole numbers was documented in the work of Mack (1990), who emphasized that students frequently approached fractions as isolated entities, failing to perceive them as part of a broader numerical system. This lack of holistic understanding prevents students from developing a sound conceptual framework for dealing with fractions in various mathematical contexts. The presence of such misconceptions in the current study suggests that similar instructional strategies may be needed to rectify misunderstandings and develop foundational knowledge.

The theoretical framework employed in this study, rooted in constructivist principles, underscores the importance of active learning and the construction of knowledge through experience. Vygotsky's (1978**)** theories on social constructivism suggest that social interactions facilitate cognitive development. The findings from this study, particularly regarding the positive impact of Teacher's interventions, resonate with these theoretical underpinnings. Teacher's strategic use of visual aids and real-world applications exemplifies the constructivist approach, allowing students to build connections between abstract concepts and tangible experiences.

Furthermore, the framework aligns with Piaget's (1970) developmental theory, which posits that students progress through stages of cognitive development. The manipulation of fraction tiles and the contextualization of fraction problems reflect an understanding of students' operational cognitive levels, catering to their readiness to learn. The active engagement of students during collaborative tasks echoes Piaget's emphasis on social interaction as a critical element in advancing cognitive understanding.

The significance of collaborative learning, as noted in the observed classroom dynamics, is further supported by Johnson and Johnson (1994), who found that cooperative learning structures positively impact student achievement, motivation, and attitudes toward learning, which were evident in this study. As students engaged in discussions and supported one another, they not only addressed individual misconceptions but also fostered a collective understanding of the material, illustrating the strength of peer-assisted learning.

The analysis reinforces the notion that a singular, traditional approach to teaching fractions is inadequate for addressing the diverse misconceptions students hold. The combination of teacher-led intervention and opportunities for peer interactions, as demonstrated in this study, emerges as a powerful pedagogical tool for enhancing fraction understanding. Aligning instructional strategies with the theoretical framework allows educators to create an environment where active engagement and collaborative learning are prioritized.

Additionally, considering the implications of these findings suggests a need for tailored professional development programs that equip teachers with strategies to identify and address specific misconceptions in their classrooms. Teachers should be encouraged to implement hands-on learning activities and contextually relevant examples that resonate with students' experiences, prompting deeper engagement and understanding.

The findings of this study on students' misconceptions about fractions substantially align with the existing literature and the theoretical framework guiding this research. The prevalent misunderstandings illuminate the necessity for instructional approaches rooted in constructivist principles, where active engagement, social interaction, and contextual learning are emphasized. By prioritizing these elements in mathematics education, educators can significantly improve students' fraction comprehension and overall mathematical proficiency. Future research may expand on these findings by exploring additional factors that influence students' understanding of mathematics and developing innovative pedagogical strategies that cater to diverse learning needs.

4.4 Chapter Summary

In summary, this chapter has presented an analysis of data collected through observations, written assignments, and interviews to understand misconceptions regarding fractions among students at Jenya Secondary School. The findings indicate significant levels of student engagement but reveal persistent misconceptions that hinder mathematical understanding. The role of the teacher as a facilitator emerged as a crucial element in addressing these misunderstandings, with collaborative learning environments fostering peer interactions that led to meaningful discussions and the rectification of misconceptions. This underscores the necessity for targeted instructional strategies aimed at clarifying foundational concepts in fractions, aligning with the literature reviewed earlier in this study.

Chapter Five: Summary, Conclusion, and Recommendations

5.1 Introduction

This chapter presents a synthesis of the research findings concerning students' understanding of fractions at Jenya High School in the Chivi District. The insights gained from the study will be summarized, highlighting the main research findings. Following this, specific recommendations will be made to improve teaching strategies and address misconceptions about fractions. Finally, the chapter will outline suggestions for further research endeavors, emphasizing areas that require additional exploration.

5.2 Summary of the Research

The research was conducted to explore learners' reasoning and misconceptions around fractions in a secondary school setting. Through a combination of observational methods, written assignments, semi-structured interviews, and collaborative tasks, data were collected from 30 students. The findings revealed both heightened engagement during fraction lessons and persistent misconceptions that hinder their understanding of fractions. Informative feedback indicated the positive role of collaborative learning in clarifying these misconceptions. Overally this study underscores the critical need to address the conceptual understanding of fractions among secondary students, as foundational knowledge is instrumental for their continued success in mathematics.

5.3 Main Research Findings

The study yielded several key findings:

The research conducted at Jenya High School has yielded significant insights into students' understanding of fractions and the misconceptions that often accompany this mathematical concept. Through a comprehensive data collection process involving observations, written assignments, and semi-structured interviews, several core findings emerged that elucidate both the strengths and challenges faced by learners in mastering fractions.

One of the most prominent findings of the study was the high level of student engagement observed during lessons focused on fractions. The instructional strategies employed, which included the use of visual aids, hands-on activities, and collaborative learning opportunities, significantly enhanced student participation and motivation. Many students expressed enthusiasm for engaging with concrete representations of abstract concepts, such as number lines and fraction manipulatives. This heightened engagement suggests that when students are actively involved in their learning process, they are more likely to develop a deeper understanding of the material. Such instructional methods not only foster a collaborative learning environment but also encourage students to think critically about the mathematical concepts presented.

However, alongside this engagement, the research revealed persistent misconceptions regarding fractions that hinder students' mathematical progress. A particularly widespread misunderstanding was the belief that a higher numerator always indicates a larger fraction. This misconception was evident in students' inability to accurately compare fractions, as many would assert that fractions with larger numerators were superior in value without considering their denominators. For example, students often believed that (frac3/4) was larger than (frac2/5) purely based on the numerators. Such misunderstandings underscore the necessity for educators to explicitly teach students the foundational concepts surrounding the magnitude of fractions, emphasizing the reciprocal relationship between the numerator and the denominator.

Additionally, the study illuminated the issue of students conflating fractions with whole numbers. Many learners approached fractions as isolated entities rather than as part of a broader numerical system, leading to confusion in operations involving fractions. This conflation appeared during lessons on operations such as addition and subtraction, where students frequently neglected the critical requirement for a common denominator. The observations indicated a need for greater emphasis on the relationships between fractions and whole numbers, as well as the roles that different numbers play in calculations involving fractions.

The teacher's role emerged as a crucial element in addressing these misconceptions. The study highlighted how effective teacher interventions—such as promoting inquiry-based learning, using real-world applications, and deploying visual representations—helped students to clarify their misunderstandings about fractions. The findings align with literature that emphasizes the importance of teachers acting as facilitators who guide students through complex mathematical concepts. By providing context and relevance to the material, teachers can significantly impact students' comprehension of fractions.

Furthermore, the collaborative nature of the classroom significantly contributed to students' understanding and correction of misconceptions. Peer interactions were observed to be a vital component of the learning process, allowing students to articulate their thought processes and clarify misunderstandings. Students noted that working together helped them see alternative approaches and perspectives on solving fraction-related problems. This cooperative environment not only fostered a sense of community and support among students but also enhanced their understanding of fractions through shared reasoning and problem-solving.

Lastly, the need for more tailored instructional strategies surfaced as a key area for improvement. The research indicated that while students demonstrated engagement, their understanding of fundamental concepts varied widely. There is a pressing need for targeted instructional interventions that cater to the diverse learning needs of students. This includes incorporating regular formative assessments, providing constructive feedback, and emphasizing practical applications of fractions in real-life situations to solidify their understanding.

The findings from this research reveal that while students at Jenya High School exhibit high levels of engagement during fractions instruction, they simultaneously grapple with significant misconceptions. The issues of misunderstanding the relationship between numerators and denominators, conflating fractions with whole numbers, and the pivotal role of collaborative learning underscore the complexities of teaching fractions. Additionally, effective teacher facilitation is paramount in addressing these challenges and enhancing students' comprehension of this fundamental mathematical concept. As educators strive to improve instructional strategies, it is essential to build on these findings, providing students with the foundational knowledge and supportive learning environment necessary for achieving mathematical literacy.

5.4 Recommendations

Based on the findings, the following recommendations are proposed:

Teachers should utilize various visual aids, such as number lines, fraction circles, and manipulatives, to help students grasp the concept of fractions and their relative magnitudes.

Educators should receive training on constructivist principles and collaborative instructional strategies that can facilitate deeper engagement and comprehension of fractions among students.

Schools should incorporate more group-based learning tasks that promote discussions about fractions, allowing students to learn from one another and correct misconceptions collectively.

Instruction should emphasize practical applications of fractions in real-world scenarios, such as cooking and sharing, to help students make meaningful connections to the material.

Continuous assessment of students' understanding should be conducted, providing regular feedback to guide students in identifying and correcting their misconceptions.

5.6 Recommendations for Further Research

To further understand and improve fractions comprehension in secondary education, the following areas are recommended for future research:

Examining how socio-economic backgrounds influence students’ mathematical reasoning and misconceptions about fractions.

Evaluating the effectiveness of technological tools and apps designed to teach fractions in classrooms, assessing their impact on learning outcomes and student engagement.

5.7 Chapter Summary

This chapter provides a concise overview of the research findings and their implications for teaching fractions at Jenya Secondary School. It emphasizes the importance of addressing misconceptions, utilizing collaborative learning, and enhancing teacher facilitation. With clear recommendations and suggestions for future research presented, this study aims to contribute valuable insights toward improving mathematical proficiency and educational practices surrounding fractions, ultimately fostering better outcomes for students in Zimbabwean secondary schools. By adopting a constructivist approach and prioritizing student engagement, educators can effectively mitigate misconceptions and enhance learners' overall mathematical literacy.

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APPENDIX A: Teaching Observations and Field Notes

- **Observer Details**: Name, date, time, and lesson topic
- **Classroom Setting**: Description of the classroom environment and materials used.
- **Observation Framework**: A checklist or categories to guide observations.

Observation Framework:

Aspect Observed	**Notes/Comments**
Student Engagement	Level of participation (e.g., high, moderate, low)
Misconceptions Noted	Specific misconceptions observed during discussions or activities
Teacher Interventions	Strategies used by the teacher to address misconceptions
Peer Interactions	Types of interactions among students (e.g., collaborative, competitive)
Overall Dynamics	General classroom atmosphere (e.g., supportive, tense)

Instructions:

- Use this framework to take notes during the lesson.
- Pay attention to specific students and their contributions.
- Record any relevant interactions or incidents that exemplify key concepts.

APPENDIX B: Written Assignments

Written Assignment (Post-Lesson Task):

1. **Short-Answer Questions**:

- What is the main concept learned in today's lesson? Please explain it in your own words.
- Describe one misconception you had before this lesson and how it has changed.

2. **Concept Map**:

- Create a concept map that illustrates the relationships between the key ideas discussed today. Include terms, connections, and brief explanations.

3. **Reflective Essay**:

- Write a short essay (300-500 words) reflecting on what you learned today. Discuss how your understanding of the topic has evolved and any challenges you faced.

Instructions:

- Complete each section of the assignment with thoughtful responses.
- Use examples from the lesson to support your answers.
- Submit your assignments by the end of the day.

APPENDIX C: Semi-Structured Interview Guide

1. What did you find most engaging about today's lesson?
2. Were there any concepts that were particularly difficult for you? Can you explain why?
3. Can you describe a moment in class where you felt confused? How did you address this confusion?
4. How did working with your classmates influence your understanding of the material?
5. What strategies do you think could help you and your peers better understand these complex concepts?

Instructions:

- Each interview will last approximately 30-45 minutes.
- Interviews will be audio recorded (with participant consent) for accuracy.
- Encourage participants to elaborate on their responses for deeper insights.

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Collaborative Task:

Group Activity: Conceptual Challenge

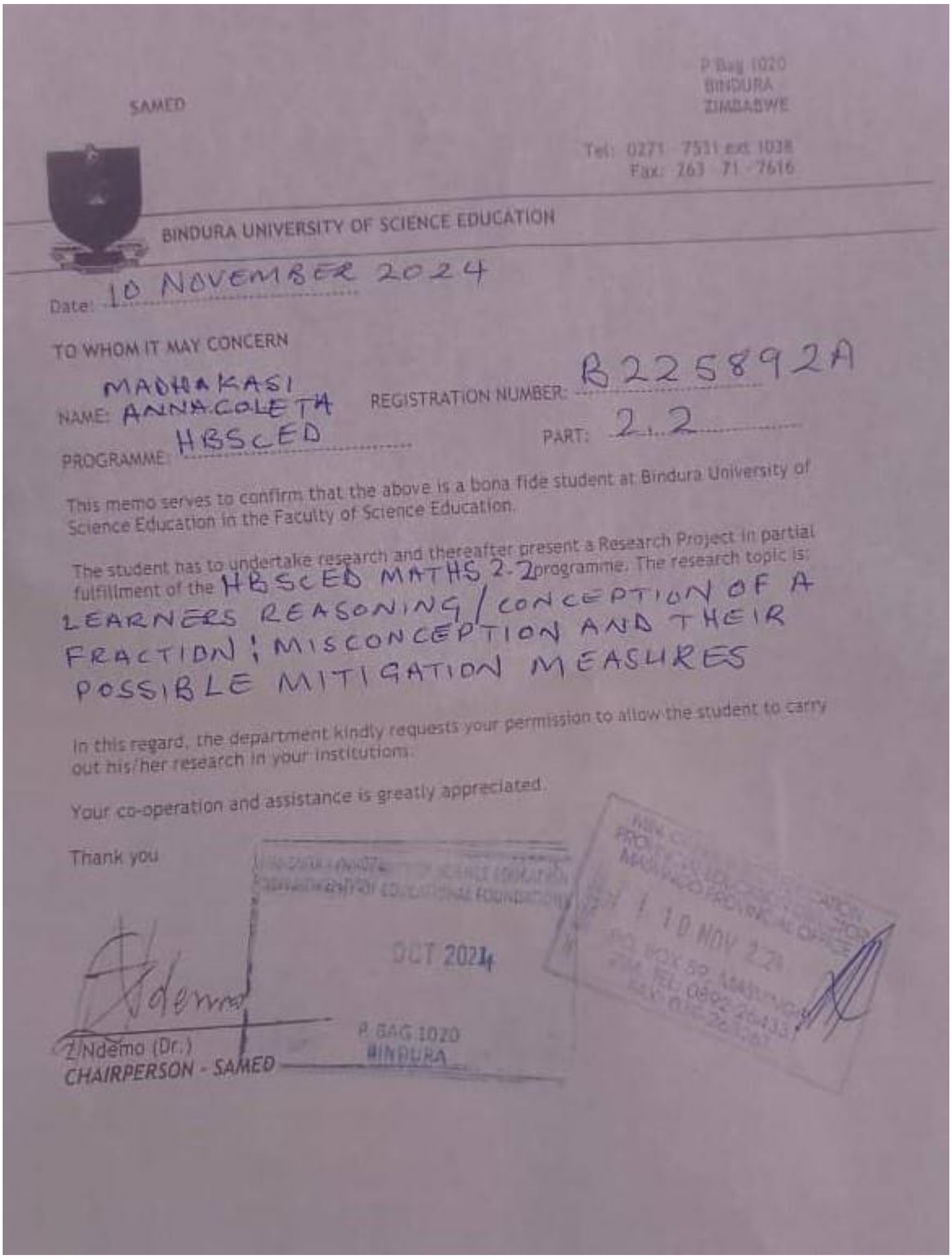
- **Task**: In groups of 5, discuss the following problem related to the lesson topic. Each group must present their solution to the class in 10 minutes.

Problem: "We discussed the water cycle in class. Create a presentation that explains how this cycle affects weather patterns. What misconceptions do you think people often have about the water cycle?"

- **Materials Needed**: Chart paper, markers, and access to reference materials (textbooks, notes).

Instructions:

- Work together to brainstorm ideas and prepare your presentations.
- Ensure every group member contributes to the discussion and presentation.
- Be ready to answer questions from your classmates after your presentation.



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BINDURA UNIVERSITY OF SCIENCE EDUCATION

Date: 10 NOVEMBER 2024

TO WHOM IT MAY CONCERN

NAME: MADHAKASI ANNA COLETA REGISTRATION NUMBER: B225892A

PROGRAMME: HBSCED PART: 2.2

This memo serves to confirm that the above is a bona fide student at Bindura University of Science Education in the Faculty of Science Education.

The student has to undertake research and thereafter present a Research Project in partial fulfillment of the HBSCED MATHS 2.2 programme. The research topic is: LEARNERS REASONING / CONCEPTION OF A FRACTION ; MISCONCEPTION AND THEIR POSSIBLE MITIGATION MEASURES

In this regard, the department kindly requests your permission to allow the student to carry out his/her research in your institutions.

Your co-operation and assistance is greatly appreciated.

Thank you

Z Ndemo (Dr.)
CHAIRPERSON - SAMED

OCT 2024
P. BAG 1020
BINDURA

10 NOV 2024

APPENDIX E Letter of permission to contact a research