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APPROACHES AND CHALLENGES IN TEACHING FRACTIONS: THE VOICES OF PRIMARY SCHOOL MATHEMATICS TEACHERS IN INCLUSIVE CLASSROOMS

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Abstract

Fractions are cited as one of the challenging concepts in school mathematics for both pupils and teachers. Against this background, this study explored Ghanaian primary school teachers' approaches and challenges of teaching fractions in pilot-inclusive schools within the Effutu Municipality of the Central Region, Ghana. In doing this, the study employed the phenomenological case study to find out the approaches these teachers employ in their teaching while highlighting the challenges that come with it. Using an in-depth conversational interview, ten (10) certificated teachers were purposively sampled to share their experiences and challenges of teaching fractions. Thematic data analysis was applied to the qualitative data from the interviews. Findings indicated that teachers use a variety of strategies, including question and answer, class discussion, demonstrations, paper aids, board illustrations, and real-life context when teaching fractions in inclusive settings. However, challenges are encountered in spelling pluralised fraction names and ensuring equal object partitioning. The study recommended additional support systems, including adequate special education resource teachers, instructional materials, training sessions, and targeted professional learning community (PLC) programmes for teachers in these inclusive classrooms.

Keywords: *challenges, Effutu, fractions, inclusive schools, strategies.*

Introduction

The concept of inclusion in education originated from the 1994 World Conference on Special Needs Education held in Salamanca, Spain (Ainscow, 2020). Initially, inclusive education was broadly defined as a means for schools to cater to all children, especially those with special educational needs (UNESCO, 1994). However, in 2019, UNESCO defined inclusion to ensure equal access to high-quality learning opportunities for all learners (Ainscow, 2020). UNESCO (2017) further elaborated on this concept, explaining that inclusion involves reaching all individuals and addressing the needs of all students studying in schools. This means that any school system that seeks the participation of children with special needs in learning alongside their peers in regular schools is deemed an inclusive education. Through this, the ultimate goal is that all children will have their needs met without discrimination in accessing quality education.

This global understanding of inclusive education has shaped national education policies, including those in Ghana. In the Ghanaian context, Darko (2015) highlights that the Education Strategic Plan (2010-2020) mandates the Ministry of Education to ensure the provision of equal and high-quality education for all learners, including those with physical and mental impairments, orphans, and students who are slow or fast learners. The plan emphasises the inclusion of these learners, whenever possible, within the mainstream formal system. Only when necessary, should they be placed in special units or schools, in line with Article 25 (1) of the 1992 Constitution of the

Republic of Ghana, which guarantees equal educational opportunities and facilities for all learners. To fulfil the goals of the inclusive education policy, the Government of Ghana has implemented various initiatives, including free and compulsory education, the Capitation Grant, the abolition of school fees, nutrition and school feeding programmes, and the establishment of pilot inclusive schools across the country. These pilot schools have been established in three regions: Central, Greater Accra, and Eastern Region (Sarpong & Kusi, 2019).

In the context of mathematics education, the concept of inclusion is seen as an adjustment in teaching approaches to facilitate learning for all students in the mathematics classroom. This includes addressing the needs of specific student groups, such as low achievers in mathematics (Alderton & Gifford, 2018). Secher-Schmidt (2016) emphasises that inclusion in mathematics involves ensuring every student can participate in mathematical activities to promote equal and quality participation and access to mathematics learning for all learners (Roos, 2019). As a result, the term "mathematics for all" has been used to describe the goal of inclusivity in mathematics education (Chronaki, 2018). This implies that Ghanaian learners facing various forms of disability, including physical and mental impairments, orphans, and those who are slow or fast learners and are placed in mainstream classrooms, should be able to learn mathematics in a way that meets their specific learning needs.

In Ghana, efforts to operationalise inclusive education in mathematics can be observed in districts like the Effutu Municipality, which currently has 22 basic schools that are part of a pilot programme for inclusive education, as noted by Darko (2015). These schools were selected to support learners of all abilities and champion inclusive teaching practices. However, studies conducted in Effutu have revealed several challenges faced by these pilot inclusive schools, including inadequate facilities, limited instructional resources, and a shortage of trained personnel, all of which impact the overall performance of the pupils, particularly in mathematics (Darko, 2015; Sarpong & Kusi, 2019; Quaye, 2023).

One specific area of difficulty in mathematics instruction within inclusive classrooms is the teaching and learning of fractions. According to Pedersen and Bjerre (2021), teachers and learners face significant challenges in understanding and conveying the concept of fractions effectively. A fraction is defined as a number in the form a/b, where a and b are integers and b is not zero (Kalra et al., 2020). Fractions play a crucial role in school mathematics and everyday life. Proficiency in fractions is considered a prerequisite for students' success in subsequent mathematical topics, including decimals, percentages, ratios, proportions, algebra, geometry, and statistics (Makhubele, 2021). Fractions are also encountered in everyday situations, such as dividing food into equal portions or understanding the quantity of items divided into multiple parts (Muharram et al., 2019). This leaves no doubt why the concept is taught at all levels of the Ghanaian education system, starting from Basic One (NaCCA, MoE, 2019; 2020).

Despite its importance, many students struggle to understand fractions, especially those in inclusive classrooms. Similar findings were reported by Kırmızıgül (2022), who found that many teachers in inclusive classrooms often struggle to employ effective methods for teaching fractions. In Effutu, Quaye (2023) identified mathematics difficulties among special needs pupils in inclusive settings. Similarly, while Baidoo and Bondzie (2024) found that these pupils had erroneous thinking processes about algebraic word problems, Baidoo and Ali (2024) reported a pervasive difficulty in solving real-life context-based algebra tasks. Additionally, the researchers of this study had the opportunity to engage teachers in interactions about teaching mathematics, and it came to light that many teachers face difficulties in teaching some topics in mathematics, including

fractions. Studies conducted by Mills and Mireku (2016) in Effutu also confirm the serious challenges students face in learning fractions. Quaye (2023) further discovered that inclusive teachers in Effutu employed ineffective teaching methods for aspects of mathematics, including number operations.

In light of these challenges, the role of the teacher becomes increasingly critical in the implementation of inclusive mathematics education (MoNE, 2020). This responsibility is particularly demanding in inclusive classrooms where a single teacher must address the needs of learners with diverse abilities (Korang & Umbugadu, 2020). Consequently, teachers require extensive knowledge and skills in both content and pedagogy to effectively meet the needs of all learners (Hettiarachchi & Das, 2014). Given the critical role of teachers' knowledge and skills in implementing inclusive mathematics education to cater to the diverse needs of all learners in regular classrooms, the researchers were motivated to explore the strategies and challenges faced by these teachers in inclusive classrooms during the teaching and learning of such a challenging mathematical concept as fractions.

Globally, while previous studies have delved into inclusive mathematics education, many have touched on general inclusive practices rather than specific topics such as fractions (Roos, 2023). This necessitates a study that addresses a pressing question in mathematics education: What strategies do teachers find effective for teaching fractions to diverse learners in inclusive classrooms? Exploring this issue can offer insights into best practices adaptable across various inclusive education contexts, thereby contributing meaningfully to the broader field of inclusive mathematics education. Although some studies, such as those by Chamane (2016) in South Africa and Ikhwanudin and Suryadi (2018) in Indonesia, have explored experiences related to teaching and learning fractions, they focus primarily on students' experiences and were conducted in non-Ghanaian contexts. This leaves a critical gap in understanding the experiences of teachers in inclusive Ghanaian classrooms.

In Ghana, related studies have focused on teachers' implementation of inclusive education (Amshetu, 2019), emerging issues from inclusive practices in Swedru (Defor, 2017), barriers to inclusive education (Vuuro, 2016), assessment practices in inclusive schools (Adzanku et al., 2021), and the performance of special needs students in mathematics (Dorleku et al., 2019). These studies contribute to understanding inclusive education within the Ghanaian context, but their findings also hold international relevance by highlighting the universal challenges and barriers in implementing inclusive practices effectively. Hence, as this study explores the teaching of fractions specifically, this study aims to fill a critical gap in mathematics education research, offering strategies and insights that could inform global practices in inclusive mathematics classrooms. However, a review of existing studies reveals a significant gap at the national level, as only a few of these studies have examined the issue within the context of mathematics. Moreover, there is a lack of studies specifically targeting teachers' experiences of teaching specific topics in mathematics within these inclusive classrooms, with no research conducted on the teaching and learning of fractions in inclusive settings.

This gap is particularly evident in Effutu, where limited studies have explored the specific challenges that teachers face when teaching fractions to diverse learners. Existing studies in the municipality have concentrated on general inclusive practices (Darko, 2015), challenges faced by school leaders (Sarpong & Kusi, 2019), pre-service special needs teachers' experiences in learning mathematics (Ali, 2021), and the teaching of basic operations to visually impaired students

(Quaye, 2023). These studies, while informative, do not address how fractions are taught or the pedagogical experiences of teachers in inclusive classrooms.

Therefore, conducting a study of this nature will provide valuable insights into the specific strategies employed and the challenges faced by primary school mathematics teachers in the Effutu Municipality when teaching fractions to a diverse range of students. By exploring their experiences, the study will spotlight both the methods teachers use and the difficulties they encounter in inclusive classrooms. These insights will inform teaching practices and guide policy development in inclusive education in Ghana and similar global contexts. The findings could offer practical strategies for addressing common challenges in diverse classrooms worldwide. Additionally, this research will help evaluate the effectiveness of current instructional practices for teaching fractions in inclusive schools and contribute to developing more responsive and equitable educational policies and teaching approaches. Based on this context, the study explored the approaches and challenges primary school mathematics teachers face when teaching fractions in pilot inclusive classrooms within the Effutu Municipality. From this broader aim, the following research questions were formulated:

1. What approaches do primary school mathematics teachers use to teach fraction concepts in inclusive classrooms in Effutu?
2. What challenges confront primary school mathematics teachers in teaching fraction concepts in inclusive classrooms in Effutu?

A. Theoretical framework

The study is grounded in the triadic reciprocal determinism model proposed by Albert Bandura (1986) and the social model of disability by Mike Oliver (1996).

The triadic reciprocal determinism model suggests that an individual's behaviour, personality, and environment interact and influence each other. Bandura (2001) explains that personal/internal and environmental factors shape human behavior. Recent studies affirm this perspective by showing that academic achievement is influenced by the continuous interaction between students' personal factors (such as self-efficacy, motivation, and attitudes) and their school and home environments (Ahn & Bong, 2019; Schunk & DiBenedetto, 2020). These personal factors, including students' abilities, interests, and beliefs, play a critical role in shaping learning outcomes and engagement in the classroom (Zee & Koomen, 2016). The social model of disability, as proposed by Oliver (1996), posits that disability is primarily a result of societal barriers, prejudices, and exclusion. This model emphasises that the social environment is crucial in defining who is considered disabled in a particular society. Disability is a collection of conditions created by the social environment, and societal modifications are necessary to facilitate full participation and inclusion. Degener (2016) notes that this requires attitudinal and ideological social changes, which ultimately become a matter of human rights at the political level.

In the context of this study, the social learning theory suggests that teachers' experiences, challenges, and coping strategies in teaching fractions in inclusive classrooms are influenced by their level of self-efficacy beliefs (low or high) about working with students with diverse special needs, as well as environmental factors relating to the school, pupils or colleague teachers. Brownell and Pajares (1999) argue that teachers who perceive themselves as competent in teaching students with special needs are more likely to engage in effective instructional practices. Their self-efficacy beliefs are associated with their perseverance in making accommodations and their

reported success in educating these students. Additionally, Landrum and Kauffman (1992) found that their colleagues perceive teachers with higher levels of skills as more capable of instructing students with special needs.

B. Conceptual Framework

The conceptual framework describes the relationship between the factors related to the primary school mathematics teacher, the environment, and certain behaviours that influence the teaching of fractions in inclusive classrooms in the Effutu Municipality. The diagram shows that teaching fractions in an inclusive classroom depends on the approaches the teacher adopts, which are influenced by specific challenges arising from personal, environmental, and behavioural factors. Personal factors such as the mathematics teacher's beliefs about inclusive education, their self-efficacy in teaching fractions, and their prior knowledge and experience in inclusive teaching influence one another and affect how fractions are taught. Similarly, environmental factors such as the classroom setting, available resources, and the accessibility of instructional materials and technologies also impact the teaching process. In addition, the behaviours and perceptions of students' parents and the wider community toward inclusive learners can influence the teaching of fractions. Therefore, teachers need to adopt appropriate strategies to overcome these challenges and effectively achieve the goals of teaching fractions. These factors interact with one another and collectively influence the quality of inclusive mathematics education in the Effutu Municipality.

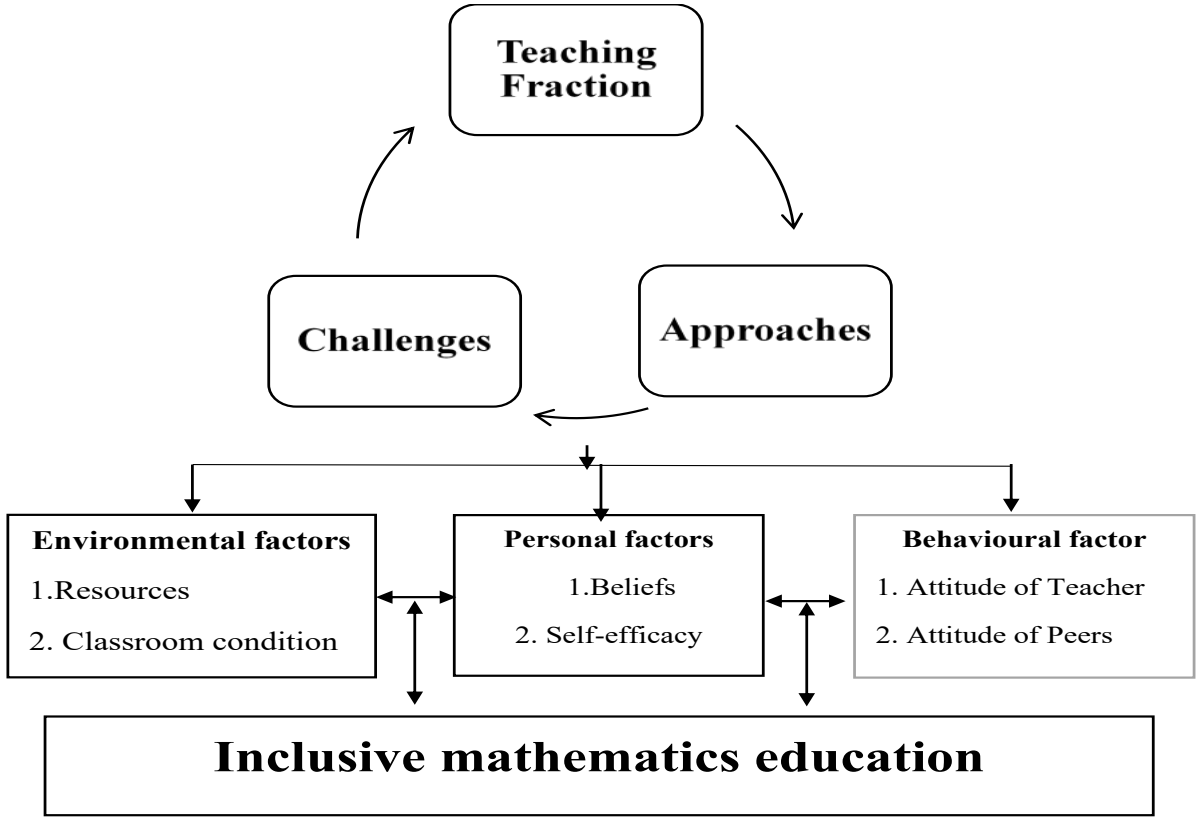

Figure 1: Conceptual framework on Inclusive Basic School Teachers' Approaches and Challenges of Teaching fractions.
(Source: Researchers' Construct, 2023)

Materials and Methods

Based on the objectives, this study adopted the phenomenological case study design of the qualitative approach underpinned by the interpretivist paradigm. This study chose the qualitative approach to explore the problem under study in depth (Creswell & Creswell, 2017). Phenomenology was also used since the study sought to understand the current lived experiences of the teachers and determine the approaches and challenges in their daily teaching of fractions in inclusive classrooms. According to Creswell and Poth (2016), phenomenology studies seek to interpret individuals' experiences and determine their perceptions, perspectives, thoughts, or feelings. This was embedded in the case study design, where the pilot inclusive schools within Effutu were considered a case. According to Creswell and Creswell (2017), a case study is used to explore and understand the meaning people give to a social phenomenon, allowing for an in-depth understanding of a phenomenon in the socio-cultural contexts of participants.

The study involved ten (10) basic school mathematics teachers purposively sampled from different pilot inclusive basic schools in the Effutu Municipality. This consisted of four males and six females. Several factors influenced the sample size. First, after interviewing this number of teachers, the researchers noticed no new information was generated, hence the need to terminate the interview. This also aligns with the recommendation by Polit and Beck (2010) that for a qualitative study, the sample should be between 10 and 12 participants. The purposeful sampling was used to ensure the selection of a data-rich sample in accordance with the purpose of the research (Buyukozturk et al., 2018). The study chose Effutu Municipality because it is one of the districts devoted to piloting inclusive education in the country. Again, it was the very district where the researchers of this study reside and work as teachers, and as such, the context in which they identified this peculiar problem.

A semi-structured interview guide was used for this study. The instrument was considered the most appropriate for collecting data as it allows for open-ended questions and the opportunity to ask additional questions as needed (Creswell & Creswell, 2017). Also, the guide is flexible and offers participants the opportunity to express their views freely while giving the interviewer the freedom to divert from the questions in the interview guide where the need arises for further clarifications to be sought (Doyle, 2024). The basis of the questions in the interview guide was the research questions. As such, questions were categorised into three aspects based on the research questions to explore the teachers' views on their instructional approaches, and challenges in the teaching and learning of fraction concepts in inclusive classrooms.

The researchers met with the teachers and scheduled interview sessions with each of them. Each interview lasted between 30 and 40 minutes and was audio-recorded with the participants' consent. After all sessions were completed, the interview data underwent thematic analysis. The recorded interviews were first transcribed into text. The transcribed data were read multiple times to gain a general understanding of the participants' experiences and views. Following this, meaning units were identified, and open coding was applied to capture key ideas related to the teaching and learning of fractions in inclusive classrooms. These open codes reflected the participants' perspectives on their teaching approaches and the challenges they encountered. The coded data were then reviewed and grouped into broader categories to form themes. Thematic analysis was used because it is well-suited for identifying, analysing, and reporting patterns within qualitative data. It allowed the researchers to systematically interpret teachers' experiences and uncover common themes related to instructional strategies and challenges in inclusive mathematics classrooms.

In this study, the researchers addressed credibility, confirmability, dependability, and transferability issues. In doing so, the responses of teachers were reported using direct quotations. Dependability was ensured through audio taping of interview sessions to have verbatim responses. Confirmability was guaranteed by following the right procedures for a qualitative study. Credibility was also enhanced by presenting the final transcripts to teachers for member-checking, allowing them to confirm their responses. The transferability was also ensured by clearly outlining the study's context and procedures, such that these findings are valid only in other contexts similar to that of this study. Similarly, the interview guide was vetted by expert lecturers at the University of Education, Winneba.

Results and Discussions

This section presents the findings of the study. Table 1 gives the background details of the ten teachers who participated in the study. It includes their gender, age, qualifications, years of mathematics teaching experience, inclusive training received, class level taught, and the number and type of special needs learners in their classrooms.

Table 1: Demographic information of Participants

Participants ID	Gender	Age	Academic Qualification	Mathematics Experience	No. of Inclusive training	Class	Special needs
T1	Female	29	Diploma	3 years	0	Basic 1	2 [Visual & Intellectual]
T2	Female	28	Bachelor's Degree	6 years	5	Basic 2	2 [Visual & Intellectual]
T3	Female	37	Bachelor's Degree	13 years	4	Basic 2	2 [Visual & Behavioral]
T4	Male	33	Bachelor's Degree	5 years	0	Basic 1	1 [Intellectual]
T5	Female	45	Bachelor's Degree	16 years	4	Basic 5	2 [Hearing]
T6	Female	39	Bachelor's Degree	21 years	5	Basic 1	6 [Intellectual & writing]
T7	Female	35	Bachelor's Degree	8 years	5	Basic 1	5 [Hearing & Writing]
T8	Male	33	Diploma	3 years	5	Basic 3	2 Writing]
T9	Male	34	Bachelor's Degree	9 years	7	Basic 4	2 [Intellectual]
T10	Male	30	Diploma	6 years	4	Basic 6	2 [Hearing & Intellectual]

Source: Field work (2023)

Data in Table 1 shows that the study involved ten teachers, comprising six females and four males. This is typical of most Ghanaian classrooms, where females seem to dominate. The teachers involved had diverse qualifications, with the majority holding bachelor's degrees and two with diploma certificates. This suggests a positive trend of teachers upgrading their academic background in the Effutu Municipality. Additionally, the teachers had diverse years of experience teaching mathematics, ranging from 3 to 21 years. Three teachers had over ten years of experience, five had nearly a decade, and only two had less than five years of experience. Notably, two of the teachers reported having no training in inclusive education despite teaching in pilot inclusive schools.

In contrast, three of the teachers had attended 4 different training sessions, four others attended 5, and one teacher had experience from 7 training workshops on inclusive education. These teachers were drawn from different classes, ranging from Basic 1 to 6. Out of these classes, the majority of the teachers used were in lower primary classes, with four teachers handling basic 1, two in basic 2, and one teacher in each of the remaining classes. Lastly, the data revealed that teachers were responsible for classes with children exhibiting various forms of special educational needs, including visual, hearing, intellectual, behavioural, and writing disorders. Significantly, nearly every class included learners with varying degrees of intellectual disability.

Research Question 1: What approaches do primary school mathematics teachers use in teaching fraction concepts in inclusive classrooms in Effutu?

The study's findings uncovered several thematic areas related to the approaches employed in teaching fractions in inclusive classrooms. These themes revolved around teaching techniques, methods to promote collaboration, instructional materials, and assessment tools and procedures used to gauge students' academic progress. These themes are further elaborated on, along with their respective sub-themes, as follows:

Theme 1: ***Instructional Techniques for Fraction Lessons***

The findings revealed that teachers employed various techniques to teach fractions in inclusive classrooms, including question and answer, class discussion, demonstrations, paper cut-out and folding, board illustrations, and the use of real-life scenarios and objects. When teachers were asked: Can you describe some of the approaches you use to teach fractions in your class? One of the teachers stated:

> *"I normally use learner-centered techniques such as cut-outs, then I demonstrate for them to also do it." (T3)*

Another teacher remarked:

> *"For methods of approaches, I use question and answers." (T1)*

In contrast, a teacher added that:

> *"I mostly used the natural objects because of the deaf students I have. I do it more practically, using real objects while drawing on the board for them to see." (T5)*

A more comprehensive response was given by a fourth teacher who remarked:

> *"Sometimes, I use demonstration. Sometimes, I use manipulatives. Sometimes I use group work." (T9)*

These responses generally highlight the prevalence of hands-on methods, such as using real objects like fruits and paper cut-outs, in teaching fractions in inclusive classrooms. It demonstrates the teachers' recognition of the importance of tangible materials in making abstract mathematical concepts more accessible, particularly in inclusive settings. This aligns with the findings of Adom and Adu (2020), indicating that Ghanaian teachers often rely on techniques like paper folding and

demonstrations for teaching fractions. They are also in line with Quaye's findings (2023), which highlight that inclusive teachers commonly utilise instructional materials, repetition, question and answer sessions, demonstrations, and other hands-on methods when teaching mathematical concepts in inclusive classrooms by incorporating these techniques, teachers create a more inclusive learning environment where learners with varying cognitive abilities can actively participate and engage with the content. This approach allows learners, including those with special needs, to receive multiple entry points to understand fractions, a key mathematical concept.

Theme 2: ***Instructional Resources for Fraction Lessons***

The findings also indicated that teachers harnessed various instructional materials to support their approaches in teaching fractions. These materials included paper cut-outs, real objects like fruits, bundles of sticks, and pictures from textbooks. In soliciting these responses, the researchers asked, 'What instructional materials do you use as part of the approaches to teaching fractions?' A teacher explained:

> *"I use cut-out shapes for teaching fractions... and pictures from their books" (T7)*

Another teacher mentioned:

> *"For fractions, I use real objects like fruits and sometimes papers." (T6)*

Furthermore, a teacher elaborated:

> *"I use a bundle of sticks and sometimes I use charts... Fractional charts, bundle of sticks and bottle tops." (P8)*

These responses demonstrate how resourceful teachers are in their fraction lessons. The choice of resources reflects the teachers' commitment to providing concrete representations of abstract mathematical ideas. The use of real objects, such as fruits and sticks, not only supports hands-on learning but also ties the learning experience to real-world contexts, making it more meaningful and relatable for students. This strategy aligns with previous research where teachers predominantly used fraction charts (Bruce et al., 2013), area models such as rectangles, circles, and diagrams (Kara & Incikabi, 2018) in their fraction lessons.

Theme 3: ***Fostering Collaboration in Fraction Lessons***

The teachers' responses shed light on the strategies used to promote collaboration among students, ensuring that learners with special needs and those without special needs work together effectively during fraction lessons. These strategies encompass mixed ability groupings, active teacher monitoring of group discussions, the utilisation of sign language and interpreters, and leveraging students' neighborhood friendships for collaborative classwork. The researcher posed the question, 'How do you encourage collaboration and peer interaction among students when teaching fractions?' Some responses given were:

> *"We normally do group work, so we mix them so they work with each other. Sometimes they do pair work. They do it together and come and share with the class." (T9)*

Another teacher elaborated:

> *"They also have an interpreter, so as I take the orange and divide, then I call the deaf to come in front and pick half or quarter of the objects." (T5)*

In contrast, a teacher pointed out:

> *"Because they are from the same neighborhood, they usually play together at home before coming, so working together is not a problem for me." (T2)*

It is evident from the response that teachers employ diverse approaches to facilitate collaborative learning of fractions among students within inclusive classroom settings. The emphasis on group work and peer collaboration reflects a belief in the power of social learning, where students learn from one another by sharing ideas and solving problems together. Mixed-ability groupings are particularly effective in inclusive classrooms as they promote the social interaction of students with diverse learning needs, allowing for the exchange of knowledge and experiences. Additionally, the use of sign language interpreters for deaf students ensures that they are included in collaborative activities, enhancing their learning opportunities. Research by Manubey et al. (2021) highlighted the use of collaborative activities such as peer tutoring in inclusive classrooms. Pires et al. (2022) also endorse the effectiveness of mixed ability groupings in enhancing collaboration within inclusive classroom settings.

Theme 4: ***Assessment Tools and Procedures in Fraction Lessons***

The findings indicated that teachers typically do not create specialised forms of assessment for learners with special needs in fraction lessons. However, adjustments are made in terms of assessment format, time, pace, number of tasks, and grading. In doing this, teachers employ oral tasks and formative assessments, allocate extra time, and sometimes utilise interpreters to ensure a fair assessment process. The teachers were asked: What assessment procedures or tools do you use to accommodate pupils' diverse learning needs in fractions? Among the responses given were:

> *"I give them the same assessment questions. If a student has writing difficulties, I provide extra time". (T4)*

Another teacher shared:

> *"I do it orally for them because writing becomes a challenge, and during exams, I print it out and read it out while explaining it to them so they are able to do it." (T2)*

Again, a teacher stated:

> *"When I give them the question, their special needs madam will sign for them." (T7)*

The use of adjusted assessments, such as oral exams and extended time, shows teachers' understanding of the diverse needs of students in inclusive classrooms. This approach aligns with differentiated instruction practices, where assessments are tailored to the learners' individual needs while maintaining fairness and rigor. Oral assessments, in particular, allow students with writing difficulties to demonstrate their understanding without being penalised for their disabilities, ensuring equitable assessment opportunities. These responses align with the findings of Quaye (2023), who observed that teachers often use interpreters when teaching mathematics to students with diverse needs. Tomlinson and Imbeau (2023) similarly noted the use of various assessment methods, including oral tests, for differentiating instruction in inclusive classrooms. Salend and Whittaker (2018) have found that providing extra time for assessments is a common practice in inclusive educational settings.

Research Question 2: What challenges confront primary school mathematics teachers in teaching fraction concepts in inclusive classrooms in Effutu?

The findings of this study in response to Research Question 2 revealed four thematic areas: actual challenges when teaching fractions, misconceptions and difficulties that learners face in fractions, and what teachers see as underlying causes of these challenges and misconceptions. These themes are discussed as follows;

Theme 1: ***Challenges in Fraction Lessons***

The findings generally indicate that teachers in the lower classes (Basic 1-3) generally do not face significant difficulties in teaching fractions because they purport that it is just the "surface" that is taught at such levels. However, several challenges related to teaching fraction concepts in inclusive classrooms were identified in this study. These challenges include issues with spelling pluralised fraction names, ensuring the equal partitioning of objects, accurately drawing fraction parts, inadequate availability of instructional resources for fraction lessons, difficulties in converting mixed fractions into improper fractions, and transitioning from the use of real objects to symbolic representations. When teachers were asked, 'What specific challenges do you face in teaching the different aspects of fractions in the inclusive classrooms?' One teacher quickly remarked:

> *"For fractions, I do not have any challenge because the fraction is the easiest topic they learn, because we learn only half and whole. "…The only challenge is when we have more than one half, and I ask them to write it, they still write it 'halfs' instead of 'halves' (T1)*

Another teacher added:

> *"For like fractions, it is very easy for them because they just compare the top numbers and then add or subtract." (T3)*

A teacher also expressed:

> *"The challenge is how to cut objects into equal parts, and some students struggle with naming fractions correctly." (T6)*

Finally, one teacher mentioned:

> *"For mixed fractions, they have difficulty multiplying before adding them. They just want to go straight like that." (T10)*

These responses show teachers in the lower grades tend to encounter fewer challenges because the fraction content at this level is more concrete, focusing mainly on halves and wholes. This simplicity, however, does not fully prepare students for the complexities of fractions they will encounter in later years. Challenges such as misapplying pluralisation (e.g., "halfs" instead of "halves") reflect a fundamental misunderstanding of language and mathematical terminology, which can impede conceptual understanding. Moreover, issues related to partitioning objects into equal parts suggest that students may struggle with the abstract notion of division, which is central to understanding fractions. The difficulties highlighted by teachers reflect common challenges in mathematics education, especially in inclusive classrooms where students with diverse needs may require additional support to grasp abstract concepts. These challenges align with prior research by Goswami (2018), which found that students often have difficulties understanding the least common multiple (LCM) algorithm and may lack a profound understanding of why it works, leading to misconceptions and errors.

Theme 2: ***Common Misconceptions in Fractions***

Among the misconceptions learners have about fractions, the study found that the assumption that every fraction is half, irrespective of equal division, disregards different denominators, treats fractions as whole numbers, and sees fractions as difficult and strange. The researcher asked, 'Can you describe any common misconceptions that students with diverse learning needs encounter when learning about fractions in inclusive classrooms, and how you address them?" The teachers provided the following insights:

> *"Students sometimes think an object is divided equally into halves even if it's not. I emphasise the importance of equal division." (T6)*

Another teacher added:

> *"Some of them treat the addition and subtraction as whole numbers where they just add the top numbers and then add the down numbers just like that." (T5)*

A teacher also remarked:

> *"They think fractions are difficult; to them, it looks different from the normal whole numbers they see: They see two numbers, one at the top, one at the bottom, so it is strange to them." (T9)*

These findings highlight how pervasive these misconceptions are in fraction teaching and learning. Misconceptions such as treating all fractions as halves or confusing the operations for adding and subtracting fractions with those for whole numbers indicate that students struggle with the foundational understanding of fractions. This often results in oversimplifications, which hinder deeper comprehension. The perception of fractions as "strange" due to the unusual positioning of numbers (numerator and denominator) reflects learners' cognitive challenges when transitioning from whole numbers to fractions. These difficulties are often exacerbated in inclusive classrooms where students with different learning needs may require more time and support to unlearn these misconceptions. These findings align with previous research conducted by Christou and Vamvakoussi (2021), which revealed that children frequently attempt to apply whole number rules when working with fractions. It is also consistent with the observations made by Wijayanti (2017) and supports the idea that children often make errors when adding and subtracting numerators and denominators simultaneously (Önal & Yorulmaz, 2017). Intriguingly, Idris and Narayanan (2011) found that children often neglect to consider whether fractions are divided equally or not before naming them

Theme 3: ***Underlying Causes of Pupils' Challenges in Fractions***

The study identified various factors contributing to the challenges and misconceptions in the teaching and learning of fractions within inclusive classrooms. These factors encompassed learners' developmental stages, mental abilities, special educational needs, and their prior knowledge of fractions based on their home environment. Teacher-related factors included a lack of knowledge of sign language and insufficient instructional materials. Some teachers admitted having no knowledge of where these stem from. The question posed was, could you explain the causes of these challenges in fraction learning in your inclusive classrooms? The teachers responded, saying:

> *"I think it's the context in which we use the word 'half' in their homes because in our homes, when we talk about half, we don't add anything to make sure it is really equal or not. It is the home." (T2)*

Another teacher added:

> *"It is a challenge because I am not a special needs teacher. Teaching fractions is very difficult, so that you can imagine my class, that I have deaf students." (T5)*

In contrast, a teacher stated:

> *"I don't know where they learned those things from." (T4)*

The findings suggest that the varying developmental stages of students, combined with their cognitive abilities and prior knowledge, influence their ability to understand fractions. For

example, a student's understanding of fractions can be shaped by how the concept of "half" is used in their home environment, potentially leading to misconceptions. Additionally, the challenges faced by teachers, such as a lack of knowledge about special educational needs and sign language, indicate that educators may not always have the tools or training needed to support all students effectively. The finding corroborates earlier studies by Davis (2016) in which the Ghanaian home context affects the learning of school fractions. It further corroborates the findings of Quaye (2023), where teachers were found to lack effectiveness in the use of sign language for teaching mathematics lessons in inclusive classrooms. Similarly, the findings resonate with the research by Wijayanti (2017), suggesting that introducing fractions at a very early stage in children's development may contribute to the challenges they face when learning fractions.

Conclusions and Recommendations

First, it was revealed that teachers use a variety of strategies, including question and answer, class discussion, demonstrations, paper aids, board illustrations, and real-life context when teaching fractions in inclusive classrooms. Similarly, collaboration is facilitated through mixed-ability groupings, the use of sign language, interpreters, and active teacher monitoring of group discussions. Teachers generally adapt assessment methods, pacing, task quantities, and grading to accommodate students with special needs, incorporating oral tasks, formative assessments, extra time allocation, and interpreter assistance during fraction lessons. Therefore, it is recommended that teachers within Effutu continue using these strategies while availing themselves of support and training to implement differentiated instruction and assessment in their lessons.

Also, the study found that teachers in lower-grade classrooms (Basic 1-3) generally find teaching fractions manageable as they focus on introductory concepts. However, they encounter challenges related to spelling pluralised fraction names, ensuring equal object partitioning, and transitioning from real objects to symbolic representations. Common misconceptions among pupils revolve around unequal partitioning and treating fractions as whole numbers. These challenges are influenced by pupils' developmental stages, abilities, and prior knowledge, while teachers face issues like a lack of sign language skills and insufficient instructional resources. In light of this, it is recommended that the Effutu Municipal Education Directorate incorporate sign language training into their ongoing professional development programmes for teachers and prioritise the provision of adequate instructional resources to support fraction lessons in inclusive classrooms.

The researchers acknowledge that the findings may not be applicable to all the inclusive classrooms in the municipality due to the limitations of sampling a limited number of teachers from only public schools. Considering that teachers implement diverse strategies, including class discussions, real-life contexts, and differentiated assessments, to support inclusive classrooms, future researchers could explore the impacts of these methods on learning outcomes, aligning with Vygotsky's emphasis on scaffolding and collaborative learning. Also, as teachers face challenges with fractions attributed to pupils' developmental stages and resource gaps, researchers in the field can examine the influence of class levels and resources on learners' engagement and performance in fractions. These could provide further groundings for the cognitive development theory propounded by Piaget. Lastly, future researchers could explore the coping strategies that primary school teachers use to manage the challenges of teaching fractions in inclusive classrooms.

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