Exploring Teachers' Experiences of Teaching Fractions in Grade 6 in the Curriculum and Assessment Policy Statement: A case Study of One Rural School in Ndwedwe Circuit

By

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I Cynthia Nonhlanhla Chamane hereby declare that:

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ii. This dissertation has not been submitted for any degree or examination at any other university.

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Dedication

I dedicate this research to my late partner Bhoyi, whose credence in me gave the courage to continue with this journey.

I also dedicate this work to my mother Ivy, for her unswerving belief in me and all the words of encouragement.

Abstract

The aim of this study was to explore teachers' experiences of teaching fractions to Grade 6 learners in the Curriculum and Assessment Policy Statement (CAPS). It was a qualitative study that utilised the case study approach. Four mathematics teachers were purposively chosen as participants, using convenience sampling to select those who were most accessible. Data were generated through reflective activity, semi-structured interviews, and focus group discussions. The curricular spider-web was used as a conceptual framework for data analysis. The findings of the study revealed that teachers' experiences were influenced by factors such as rationale, aims and objectives, content, teaching activities, teachers' roles, resources, grouping, time, location and assessment. The rationales for teaching (personal, societal, content) were found to be the most influential component in teachers' experiences. Where teachers were guided by the personal rationale for teaching, they demonstrated a conceptual understanding of what they were teaching. On the other hand, teachers whose experiences were influenced by the societal rationale for teaching did not make decisions that contributed to successful teaching of fractions. Teachers who were guided by the content rationale for teaching believed that being knowledgeable about fractions guided them to teach fractions effectively. It is recommended that teachers must be guided by rationales in their teaching in order to influence the teaching and learning of fractions. In addition, the study recommends that there is a need for on-going professional development for Mathematics teachers so that they keep abreast with current and innovative teaching approaches, particularly for teaching fractions.

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List of Acronyms

ACARA	Australian Curriculum Assessment and Reporting Authority
AMESA	Association for Mathematics Education of South Africa
ANA	Annual national assessment
CAPS	Curriculum and Assessment Policy Statement
CASS	Continuous assessment
CDE	Centre for Development and Enterprise
DAST	Department of Arts, Science and Technology
DBE	Department of Basic Education
DoE	Department of Education
DET	Department of Education and Training
KZN	KwaZulu-Natal
MKT	Mathematical knowledge for teaching
NIED	National Institute for Educational Development
NMAP	National Mathematics Advisory Panel
OBE	Outcomes-based education
RNCS	Revised National Curriculum Statement
SACMEQ	Southern Africa Consortium for Monitoring Educational Quality
SBA	School-based assessment
TiE	Technology in education
TIMSS	Trends in International Mathematics and Science Study
UKZN	University of KwaZulu-Natal
USA	United States of America

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CHAPTER ONE

ORIENTATION TO THE STUDY

1.1 Introduction

This chapter intends to give a broad overview of and the orientation to the study. The purpose of this research study was to explore teachers' experiences of teaching fractions in Grade 6 in the Curriculum and Assessment Policy Statement (CAPS). Thus, this chapter firstly provides an overview of the background to the study followed by a statement of the problem. Next the rationale of the study is provided, followed by the objectives and the critical research questions. The limitations of the study are also given. The chapter concludes with a brief overview of the structure and the sequence of the study.

1.2 Background to the study

Mathematics education for blacks has never been in a conducive state in South Africa (Khuzwayo, 2000). Blacks were systematically discouraged from studying the discipline and this is reflected in the sentiments of Apartheid architect Hendrik Verwoerd, who in 1953 asked rhetorically, "What is the use of teaching of the Bantu child Mathematics?" Verwoerd's intentions and the broader aims of the Bantu Education Act of 1953 were for blacks to only be educated as far as it would benefit the Apartheid state, and Mathematics had no place in this kind of education. As a result, black learners were discouraged from taking Mathematics as a subject. According to the Department of Education and Training (DET) and the Department of Arts, Science and Technology (DAST), KwaZulu-Natal (KZN) did not provide Mathematics at the Grade 12 level in 1997 (Arnott, Kubeka, Rice & Hall, 1997). This had an impact not only on the type and quality of education that the black people experienced but also had an unbelievable impact on how most black people view Mathematics.

According to the Association for Mathematics Education of South Africa (AMESA) (AMESA, 2000) Mathematics is not for everybody. According to Spaul and Kotze (2015) South Africa has participated in two major cross-national comparisons of primary school student achievement: the Southern Africa Consortium for Monitoring Educational Quality (SACMEQ, 2000, 2007); and Trends in International Mathematics and Science Study (TIMSS, 2011). South Africa has the lowest average score of all low-income countries (Department of Basic Education (DBE), 2013). However, Mathematics should be taught such

that everybody will use it every day. Without Mathematics people will not be able to trade, buy, sell and do other basic calculations in their daily transactions. Hence, Mathematics is the source of all the science and technology of all human activities (Tella, 2008).

Tshiredo (2013) argues that curriculum change has made its own mark in the history of South Africa, whilst taking into consideration the effects of the Bantu Education Act of 1953. One of the most notorious consequences of the Act was the 1974 Afrikaans Medium Decree which forced learners to learn many subjects using Afrikaans as the medium of instruction. This implies that the teaching of Mathematics in Afrikaans was no exception. This was one of the key factors leading to the Soweto uprising in 1976, although there were other causes as well, including the severe lack of resources put into black education. The Mathematics curriculum developed during this period was especially designed to further and advance the interests of one race over others (Msila, 2007). In 1980 a single Ministry of Education was formed, as well as a commission for teaching and learning of Mathematics (Khuzwayo, 2005). The large majority of commission members were Afrikaner academics from historically Afrikaans-medium universities (Khuzwayo, 2005). The sum effect was that essential subjects such as Mathematics were taught insufficiently to black children.

Khuzwayo (2000) explains that one of the results of the Bantu Education Act of 1953 was that most black learners did not have access to Mathematics as a subject, as the majority of black schools did not offer it at senior secondary level. In addition, in the few schools that offered Mathematics it was taught as an abstract, meaningless subject, only to be memorised, rendering it meaningless when compared to the type of mathematics that white children were taught. Further limiting Mathematics education to black children was the fact that there was a shortage of adequately trained secondary level Mathematics teachers available to black schools. This was a direct consequence of the Bantu Education policy. Furthermore, the Apartheid education policy never intensified their knowledge; rather it reinforced the inequalities of a divided society (Msila, 2007). Therefore, Bantu education did not prepare learners fully for the mathematical concepts that lie ahead in the job market. On the contrary, the white minority of South Africans received a more privileged and higher-quality education.

Although the context in which black learners were discouraged from studying Mathematics has come to an end, the effects of the policy, which shaped the kind of education that they

received for decades, have negative effects that still linger. The rapid pace at which democracy was achieved in South Africa has not affected Mathematics reforms or its teaching in previously disadvantaged schools. During the 1990s South Africa underwent a rapid transformation due to the dismantling of apartheid. This transformation, as well as changes in the political landscape, both inside and outside the southern African region, also contributed to the need for changes in education (Jansen & Christie, 1999). Along these poverty indicators, schools are ranked in a quintile system from most poor to least poor, with the poorest schools receiving more of the budget per learner than the least poor schools. This system is designed to address problems of inequality created by the apartheid policies. In 1991, the State expenditure for white learners was 4.5 times greater than spending on black learners. There were disparities and inequalities between different racial groups, resources, rules and regulations, and also in terms of access to schools, the curriculum, quality and training of teachers, the learner-educator ratio, physical resources and the salaries of educators.

However, schools have changed in terms of their learner population, which became culturally diverse from 1994, and, in terms of curriculum and management, are more culturally responsive. Schools are public spaces. They have to recreate themselves as democratic public spaces. Educators and academics have a role to play in becoming "transformative intellectuals" as they guide learners towards a democratic society (Nel, 1995). Nel states too that a notion of democracy includes the acceptance of pluralism and the recognition of difference between groups. Differences should not be seen as deficits or reasons for not belonging. However, this also places a huge burden on teachers at schools in disadvantaged areas. In spite of many black teachers themselves not having a thorough education on essential mathematic concepts, they are faced with the additional challenges of dealing with schools that have not fully recovered from Apartheid policies.

In previously disadvantaged black schools inclusion, as it is understood by academics and policy-makers, is a practice in education whereby the needs of individual learners are successfully and adequately met. It refers, in particular, to the meeting of learners' needs in mainstream classes. Inclusion indicates a thorough commitment to create regular schools, which are inherently capable of educating all learners. This entails a radical restructuring of schools as "organisations, re-evaluation of the curriculum, and changes in pedagogical methodology" (Engelbrecht, 1999).This suggests that Mathematics teachers in black schools

should adopt inclusivity in their classes in order to catch up in the quest to teach their learners. This study is focusing on the teachers' experiences of teaching fractions in Grade 6 in CAPS. Having discussed the historical background of teaching Mathematics in black schools, it is important to discuss the statement of the problem.

1.3 Statement of the problem

It seems that teachers in Grade 6 neglect the teaching of fractions in CAPS. They experience challenges when teaching fractions in Grade 6. Kong (2008) asserts that the topic of fractions is an important section of teaching about numbers in senior primary Mathematics curriculum. Research also indicates that the teaching of fractions is difficult (Wu, 1999; Newton, 2008; Lamon, 2007; Ashlock, 2010; Gabriel, Coché, Szucs, Carette & Rey, 2012; Tobias, 2013; Pienaar, 2014). Teachers have insufficient knowledge of fractions necessary for classroom instruction (Ma, 1999; Harvey, 2012). It seems that South African teachers struggle with content for Mathematics that they teach (Bansilal, Brijlall & Mkhwanazi, 2014). Teachers' poor content knowledge of teaching fractions is one of the reasons for South African learners' poor performance in national assessments in Mathematics (Centre for Development & Enterprise (CDE), 2011). Any incorrect teaching of fractions can affect learners' understanding of the topic and can become a lifetime problem. Ultimately this will influence their schooling, tertiary education and working situations. Shulman (1986) states that teachers must have a knowledge base that is specific to the subject matter. Therefore, the rationale for research on teachers' experiences of teaching fractions in Grade 6 in CAPS is established.

1.4 Rationale for the study

As a primary school mathematics teacher for 10 years, I observed that teachers experienced problems when teaching fractions. When learners were given class exercises and assessments they performed poorly in fractions. Teachers from other schools also shared similar sentiments in this concept in Mathematics. A fraction is a concept that is part of the Grade 5 syllabus. In support of this idea, Pienaar (2014) asserts that one of the many reasons that teachers experience problems when teaching fractions may be the way in which Mathematics as a subject is viewed in the South African curriculum. The above situation prompted me to explore teachers' experiences of teaching fractions in the CAPS Grade 6 Mathematics curriculum.

Furthermore, teachers and researchers have typically described the teaching of fractions as a challenging area of the Mathematics curriculum (Gabriel et al., 2012; Ashlock, 2010). Austin, Carbone and Webb (2011) conducted a study in South Africa and the United States of America (USA) on issues that hinder prospective primary school teachers from writing acceptable problem-posing scenarios in teaching fractions. The participants were 44 pre-service teachers. The findings showed that issues that hinder the writing of acceptable problem scenarios are an inability to recognise that uniform units must be used for units to be comparable, they must be the same size and shape, that standard formal units of measurement must be used rather than informal units, and that different units of measurement cannot be used to represent the same fractional part.

Another comparative study conducted by Lin, Becker, Bryun, Yang and Huang (2013) in Taiwan and the USA centred on pre-service teachers' procedures in four areas of fraction operations, the differences in pre-service teachers' conceptual knowledge, correlation in pre-service teachers' conceptual knowledge, and procedural knowledge of fractions. The participants were 47 pre-service teachers in Taiwan and a comparable 49 in the USA. The findings indicated that Chinese pre-service teachers performed better in procedural knowledge on fractions operations than the American teachers. Furthermore, the correlation in this study showed that for both Chinese and American pre-service teachers, the relationship between conceptual and procedural knowledge of fraction operations was weak.

The above studies were grounded on teachers' experiences of teaching fractions using a quantitative approach. None of them explored teachers' experiences of teaching fractions in Grade 6 in a rural context. This shows that there is a need for a study to be conducted through a qualitative approach using a case study. Therefore this study is significant because its findings exposed the teaching strategies used by teachers when teaching fractions in Grade 6 and enabled an understanding of their experiences.

1.5 Significance of the study

Given the rationale above, this study explored teachers' experiences of teaching fractions in Grade 6 in CAPS. The study is significant because its findings may provide teachers with a platform to reflect on and interrogate their own practices in the teaching of fractions. The significance of this research may further inform circuit-level Department of Education (DoE) officials about the issues surrounding the teaching of fractions in rural schools. The findings

of the study may also be useful in informing policy makers and curriculum planners to enable positive changes in the teaching of fractions. The participants may grow through practical involvement in research, and may also gain some insights into different perspectives of the teaching of fractions through their engagement with data-generation processes. Over and above these, the findings of this research may also add to academic research and literature in the field of education.

1.6 Objectives of the study

Based on the rationale and the significance stated above, this study intends to achieve the following objectives:

1.6.1 To explore teachers' experiences of teaching fractions in Grade 6 CAPS.

1.6.2 To understand how teachers teach fractions in Grade 6 CAPS.

1.6.3 To understand why teachers have particular experiences of teaching fractions in Grade 6 CAPS.

1.7 Critical research questions

This study is driven by the following critical research questions, which emanated from the objectives of the study as stated above:

1.7.1 What are the teachers' experiences of teaching fractions in Grade 6 CAPS?

1.7.2 How do teachers teach fractions in Grade 6 CAPS?

1.7.3 Why do teachers have particular experiences of teaching fractions in Grade 6 CAPS?

1.8 Limitations of the study

According to Baloch (2011), limitations are potential weaknesses of a study and they incorporate all those factors which are impossible to avoid, thereby affecting the internal validity of research. Similarly, Simon and Goes (2013) assert that limitations are the matters that arise in a study which are out of the researcher's control. On other hand, Creswell (2008) defines limitations as shortcomings that the researcher identifies in the study. Time was the limitation in this study. Interviews were conducted during breaks and after school hours. Conducting interviews during breaks interfered with the teachers' time for lunch. Interviews conducted after school interfered with their time for going home and some teachers indicated family commitments and meetings after school.

The context was also a problem in this study. There had been robberies and hijackings at the school grounds, and therefore teachers were afraid to stay after school. To address the above mentioned issues, prior arrangements for a neutral venue and time for conducting interviews were negotiated with the participants. Additionally, the fact that I was a teacher within the very same school was also a limitation in itself. The participants thought that I was evaluating their teaching practices. As a result, one of the participants endlessly postponed taking part in the interviews. To address this, I explained to them that the study was for the fulfilment of my degree requirements and not for the DoE.

My case study was small and involved four teachers. The intense information that I received was used to identify and understand the experiences of teachers teaching factions in Grade 6 in a rural school. The size of the sample makes it difficult to generalise the population. Considering that this study did not aim to generalise, it was very important that I provide detailed descriptions of each case to gain a deeper understanding of the meanings that my participants attached to their activities. Due to the open nature of the study, participants may have tried to impress me by giving data that they felt would please me. This suggests that case studies are not easily open to cross-checking and that lead to subjectivity and bias (Cohen, Manion & Morrison, 2011). Therefore, interviews needed to be triangulated with other data sources. Cohen et al. (2011) assert that triangulation is the collection of data from a number of different sources. This study will use the reflective activity, semi-structured interviews and focus group interviews to generate data. I will use the reflection activity to overcome some of the weakness of the interviews.

1.9 Outline of the study

The chapters for this study have been arranged as follows:

- Chapter one serves as the background and contextualisation of the study, orientating the reader to the study. It includes the introduction and the justification for the study.
- Chapter two reviews the literature and conceptual framework that ground this study educationally.
- Chapter three discusses the research methodology and research design to give details on the reasons for choosing the research method (case study), methods used to generate data (reflective activity, semi-structured interviews and focus group interviews) and sampling (purposive and convenience). The authenticities of the study (credibility,

transferability, dependability and conformability) as well as ethical considerations used during this study are explained.

- Chapter four presents findings of the data that are generated from the case study using the reflective activity, semi-structured interviews and focus group interview. The findings of the study are presented thematically.
- Chapter five discusses conclusions and recommendations of the study. The main research findings are highlighted and recommendations for further studies are made.

1.10 Conclusion

The purpose of this chapter is to concisely inform the readers as to what to expect from this study. The outline of the study and a short description of each chapter were given. The next chapter will focus on the literature concerning the research topic as well as the literature involved in attempting to answer the research questions.

CHAPTER TWO
LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

2.1 Introduction

This chapter provides a synopsis of the literature that was reviewed in order to better understand and provide a contextual analysis on fractions. Creswell (2012) stated that literature review provides a framework for establishing the importance of the study as well as a benchmark for comparing the results of a study with other findings. Reviewing the literature also assists in developing a framework for giving clarity to the teachers' experiences of teaching the concept fractions in Mathematics curriculum. Additionally, the chapter attempts to explore teachers' experiences of teaching fractions in Grade 6 CAPS. This chapter further discusses the curricular spider-web as the conceptual framework, which will be the lens through which the phenomenon will be explored. Therefore, it is important to discuss the phenomenon (teachers' experiences) of teaching fractions.

2.2 Teachers' experiences of teaching fractions

Fractions and rational numbers are considered to be the most complex mathematical domains in elementary school Mathematics (Marks, 1990; Ball, 1990). Many students' understanding of fractions is characterised by knowledge of rote procedures, often, which are incorrect, rather than by the concepts underlying the procedures (Behr, Lesh, Post & Silver, 1983). Teachers' experiences are what teachers bring to their classrooms and they are built on their prior knowledge (Carin, Bass & Contant, 2005). What teachers have previously learned, their own beliefs and ideas, and their previous experiences in education, will affect what they will teach (Loucks-Horsely, Love, Stiles, Mundry & Hewson, 2003). Isiksal and Cakiroglu (2011) studied prospective Mathematics teachers' knowledge of common conceptions and misconceptions that sixth grade learners had about the multiplication of fractions. The findings showed that the prospective teachers suggested many difficulties that Grade 6 learners may have and suggests that these difficulties stemmed from the students' lack of formal knowledge and rote memorisation of the procedures. In addition, the prospective teachers suggested strategies that could be used to overcome these misconceptions or difficulties, which include group work and the provision of adequate teaching aids.

The CAPS (2011) document does not specify the roles of teachers when teaching fractions in their classrooms. However, the classroom should be an attractive environment where learners' interest is caught (Chaplain, 2003). According to the DBE (2013), learners develop meaning when they encounter mathematical experiences that proceed from known to unknown. Learners come to school with varying knowledge, life experiences and backgrounds. The learning environment should value and respect the diversity of learners' experiences so that the students feel comfortable taking intellectual risks, asking questions and posing assumptions (DoE, 2013). A crucial component of the learning environment is the emotional and affective feelings that learners bring into the classroom regarding a specific subject area (Taylor & Fraser, 2013). A study conducted by Afari, Aldridge, Fraser and Khine (2013), which involved 352 students in the United Arab Emirates and used a quantitative approach, found that there is a positive relationship between the learning environment and attitudes towards Mathematics.

Sternberg and Horvath (1995**)** identified three differences between expert and novice teachers. Expert teachers' knowledge is more extensive, accessible and organised for use in teaching than that of novice teachers. Expert teachers solve problems more efficiently within their domain of expertise and do so with little or no cognitive effort. They also engage more readily in high-order metacognitive or executive processes, such as planning, monitoring and evaluating on-going efforts at problem solving. Finally, expert teachers have more insight. They are more likely to identify information that is relevant to the solution of problems, and are able to reorganise domain knowledge to reformulate problem representations.

Another case study was conducted by Chinyoka, Mutambara and Chagwiza (2012) to investigate methods used by Mathematics teachers at the Radcliff School in Zimbabwe when teaching fractions at the ordinary level. The findings showed that the teachers were using traditional methods to teach fractions, which were anchored on practicing problem tasks, exemplification (teaching by giving examples), drill, and teaching of rules and procedures. These observations seem to suggest that the way teachers teach is heavily influenced by their beliefs on teaching. However, it has been noted earlier that "fraction" is a difficult concept to define, mainly because it has been defined by so many and is a multidimensional concept (Kong, 2008; Newton, 2009; Toluk-Uçar, 2009).

Another concern with relation to developing competence in fractions in primary school learners is the issue of the language of instruction. In South Africa, the first three years of primary school are taught in the mother tongue of the learners. In Grade 4 learners are taught in English, which, for the majority of learners, is an additional language. Hence, mathematics teachers are expected to help Grade 4 learners to transition from Grade 3 by providing them with a variety of activities after having been learning Mathematics in their mother tongue (Yun & Flores, 2008). There is empirical evidence that suggests that language has become an impediment to academic achievement in Mathematics in South Africa (Hugo, 2008). The ANA conducted in the foundation and intermediate phases, in mathematics, showed this concerning trend (DBE, 2012).

According to Yun and Flores (2008), teachers need to demonstrate the first activity using concrete objects to define the parts of fractions rather than requiring learners to memorise the activity or apply a rule. Van den Akker et al. (2009) state that teachers use resources when teaching. However, CAPS (2011) specifies the resources or materials to be used by curriculum implementers (teachers), but it is specifying only the subject content or matter – there are no prescribed materials. Therefore, the teachers must link fractions to the real world (Brijlall, 2014). This implies that Mathematics teachers must give learners concrete objects when teaching fractions. Similarly, in New Zealand and Australia, teachers are using concrete objects when teaching fractions. Concrete objects are forms of representation needed to increase learners' understanding of and operations with fractions (Brijlall, 2014). This denotes that practical activities are important for teachers teaching fractions in Grade 6.

However, Mathematics teachers must have a full understanding of pedagogical content knowledge when teaching fractions (Brijlall, 2014). Moreover, Remillard (2000) and Collopy (2003) opine that the ways in which teachers interact with curriculum materials are shaped by characteristics such as their knowledge, beliefs and experiences. Additionally, Remillard and Heck (2014) state that curriculum materials refer to resources that are designed to support teaching. They further state that textbooks are the most common form of curriculum materials used throughout the world when teaching fractions. However, teachers having experience with a particular resource or deep understanding of Mathematics will respond differently than teachers with less experience or understanding (Stein & Kim, 2009).

Based on the above perspectives, I was keen to explore the practices of teachers in teaching fractions in a Grade 6 CAPS class in a rural school, and examine the complex personal, social, political, historical, organisational and contextual influences in this particular context. Connelly and Clandinin (1999) suggested that we should examine who a teacher is and why they teach in a particular way from the perspective of teachers' experiences in context, how they engage in context and by giving them voice. Further, Lieberman and Miller (2011) argue that teachers enter the profession with prior experience of teaching and learning, as well as personal values and beliefs that inform their understandings of teaching and learning, and shape how they enact their practice. However, the concept "curriculum" is important for this study.

2.3 The curriculum

The term "curriculum" is understood and explained differently by different scholars (Braslavsky, 2003; Pinar, 2012; Odendahl, 2011). Braslavsky (2003) equates the "curriculum" with syllabus, theoretical or the context. However, Odendahl (2011) views the "curriculum" as a product, an attempt to achieve certain ends in learners. In contrast, Pinar (2012) defines the "curriculum" as the planned interaction of learners with instructional content, material, resources and processes for evaluating the attainment of educational objective. On the other hand, Ali (2012) equates "curriculum" with a syllabus, content or subject matter taught by teachers and learned by learners. This suggests that the word "syllabus" is an example of a curriculum but should not be used interchangeable with the "curriculum". Moreover, Taba and Spalding (1962) understand "curriculum" to mean a product of what learners achieve at the end of the course. On the other hand, Pinar (2014) defines "curriculum" as a process by which learners are taught to think critically, and understand their roles and the expectations that others have of them.

In addition, Hewitt (2006) defines "curriculum" as the content provided to learners as required by an authorised body responsible for schools and schooling, usually under State law. But Marsh and Willis (2007) believe that a curriculum reflects the historical, social, economic and political context of the society in which it has been produced. According to Ornstein and Hunkins (2009) "curriculum" can be defined narrowly as subjects that are taught in school, or it can be defined broadly as experiences that people require in order to be

actively involved in society. In addition, Kern, Thomas and Hughes (2010) define "curriculum" as a planned educational experience.

These definitions encompass a breadth of educational experiences, from one or more sessions, on a specific subject, to year-long courses. Thus, it can be said that "curriculum" is seen as an umbrella for education with a number of characteristic components, which include purposefulness, content, methods, learning experiences and evaluation (Carl, 2010). This suggests that teachers' experiences of teaching fractions are prompted by their understanding of the curriculum.

Adu and Ngibe (2014) assert that "curriculum" is the offering of socially valued knowledge, skills and attitudes, made available to learners through a variety of arrangements during the time they are at school. Furthermore, Van den Akker, de Boer, Folmer, Kuiper, Letschert, Nieveen et al. (2009) define "curriculum" as a plot for teaching, and suggest five levels at which the curriculum operates: the Supra (international); the Macro (national); the Meso (institutional); the Micro (teacher); and the Nano (learner). Van den Akker et al. (2009) further define three forms of "curriculum" as the intended, the implemented and the attained.
In contrast, Kelly (2009) claims that curriculum content is always driven by the direction that stakeholders want the society to take, and the direction of social change. However, in cases where intentions differ, and social change is understood differently by different stakeholders (in this case teachers), there is bound to be conflict in selecting content. In conclusion, Abbott (2010) postulates that there are great decisions to be made as far as curriculum content is concerned, and such decisions are often based on the ideologies of those concerned. This implies that when a curriculum is designed, all stakeholders should be involved. The three forms of curriculum will be discussed below.

2.3.1 The intended, implemented and attained curriculum

The intended curriculum is set forth in the content standards for a particular subject and grade level (Porter, 2006). This means that it reveals the instructional content targets for the implemented curriculum (the content to be covered in the classroom). Hirsch and Reys (2009) state that an intended curriculum guides teachers and curriculum developers on what should be taught and when various content and processes should receive emphasis in the school programme. Furthermore, the intended curriculum includes instructional material for the curriculum (Remillard & Heck, 2014). This concurs with Hoadley and Jansen's (2012)

definition that an intended curriculum is not contained in one document but comes in various documents that outline the content for learning areas and subjects, and these documents apply to different levels of curriculum.

In addition, Hoadley and Jansen (2013) state that what is set out in an intended curriculum needs to be assessed. This suggests that teachers who are teaching fractions should know the implemented curriculum as it includes different types of assessments. Moreover, teachers should assess fractions using assessment for learning, assessment as learning, and assessment of learning (Bennett, 2011). The DoE (2009) states that assessment is important in curriculum and learning. This suggests that the implemented curriculum refers to the content focus of accountability assessments that have been designed to monitor learners' progress in relation to the intended curriculum. Moreover, the attained curriculum is represented by learners' learning experiences and learning of fractions in Grade 6 (CAPS). This implies that it is the content measured by learners' assessments. Further, Remillard and Heck (2014) assert that the implemented curriculum has the greatest impact on learners' outcomes. However, Kouwenhoven (2010) argues that the implementation of the intended curriculum is extremely important to align the intended learning outcomes (competencies) and teaching and learning approaches.

This study focused on the implemented form of curriculum. Porter (2006) states that the implemented curriculum is the content of instruction delivered by class teachers, which highlights the content that learners must learn. Similarly, Thaanyane (2010) describes curriculum implementation as putting the intended into practice: in this case, the teaching of fractions in implementing CAPS. This suggests that the implementation process involves the interpretation of the intended curriculum aspects by teachers, as well as the actual process of teaching and learning. Furthermore, Erden (2010) asserts that the teachers' understanding of the intended curriculum is of great importance for effective implementation. However, the intended curriculum is defined as the content designated by State; thus implemented curriculum is the teachers' experiences of teaching fractions in Grade 6 (CAPS) (Van den Akker et al., 2009; Kurz, 2011; Thomson, Hillman, Wernert, Schmid, Buckley & Munene, 2012; Bester & Scholtz, 2012). This suggests that the implemented curriculum is the mathematics content that learners are taught, which is often offered by the district-adopted textbooks and or the individual teacher's preferences (Hirsch & Reys, 2009). The concepts of curriculum mentioned above suggest that teachers who are teaching fractions in Grade 6

(CAPS) should have a clear understanding of the prescribed, planned and intended content or syllabus.

Moreover, Marsh (1998) states that implemented curriculum refers to the actual use of a syllabus. This implies that implemented curriculum takes place when teachers implement the intended curriculum plan during teaching process in the classroom. However, Hoadley and Jansen (2013) assert the implemented curriculum also known as enacted curriculum is often beset with the challenges. This is because most teachers lack relevant content knowledge and skills for effective implementation. Therefore, fractions is the implemented curriculum since it the content designated by the State and specified at national (macro) level (Porter, 2006; Van den Akker et al., 2009; Thomson et al., 2012). Further, fractions is one of the earliest topics presented to learners after teaching the four basic operations (Thambi & Eu, 2013). Moreover, any inappropriate teaching of fractions can disturb learners understanding of the topic (Thambi & Eu, 2013).

A study by Chinnappan (2000) on eight pre-service teachers revealed that the teachers were more concerned on how they would approach teaching of fractions. This implies that teachers were less concerned about difficulties learners might face in understanding and solving problems involving fractions. The DoE (2009) states that the implementation of any curriculum is dependent on the teachers who implement it and how teachers make sense of the curriculum. This suggests that the failure or success of Mathematics curriculum depends on the teaching methods used by a teacher when implementing it. In all South African school's curriculum is planned and documented in one document called CAPS.

However, CAPS permits for distant less choice on the part of the teacher in terms of what to teach, when and how long to spend on different topics. Therefore, teachers should master how to clarify each concept before they present it to the learners during their teaching so that the learners will master it (Thambi & Eu, 2013). In addition, Young (2013) argues that the concepts are context-specific but are flexible and endlessly adaptable to new contexts and new experiences. This is applicable in teaching fraction in a Grade 6 classroom. Therefore, it is important to discuss the Mathematics curriculum.

2.4 Mathematics curriculum

The term "mathematics" originates from the Greek word "*mathema"* meaning science, knowledge or learning (Southwood & Spanneberg, 1999). The beginning of Mathematics as a discipline is imagined as conscious and subconscious meaning, rules, and preferences regarding the subject (Cai, Perry, Wong & Wang, 2009). Southwood and Spanneberg (1999) define Mathematics as an investigative process and creative activity, in which learners can be involved, and question the idea that it is a prescribed body of knowledge that is immune to any change or development.

According to Coffey (2011) Mathematics refers to the kind of mathematical skills one may need to use daily, for instance calculating costs and change in transactions, basic percentages, averages, or company weights. On one hand, Mathematics is defined as a universal language that uses carefully well-defined terms and symbols that enable human beings to think about, record and communicate ideas concerning the elements and the relationship (Peters, 2011). This implies that mathematical symbols have the same meaning to people using different languages throughout the world. Basic Mathematics entails learning the language, symbols and terms of Mathematics that allow us to understand the concepts needed to solve a problem (Freeman, 2012). Additionally, it implies that understanding is expressed, developed and challenged through language, symbols and social communication.

Interestingly, Ernest (2010) argues that excelling in Mathematics is crucial for learners as this has the potential to reward them with well-paid academic jobs. This implies that learners must pass Mathematics so that they will get well-paying jobs. Hence, it becomes necessary to teach learners to be knowledgeable in Mathematics. This suggests that underachievement in Mathematics also limits one's opportunities to study professional courses at all tertiary levels (Amunga & Musasia, 2011). As a result, Mathematics has become an important subject for future career choices (Nieuwoudt & Golightly, 2006).

According to the National Institute for Educational Development (NIED; 2009) Mathematics is a powerful language, which views the world through numbers, shapes, algebra, and informative and creative statistics. The DBE CAPS (2011) defines Mathematics as a language that makes use of symbols and notations to describe numerical, geometric and graphical relationship. This definition declares that Mathematics makes use of numbers, shapes and graphs to make meaning of real world problems. This suggests that it will not be

justifiable to talk about fractions, which are a content area in Mathematics, without first discussing the meaning of Mathematics, which is the subject. In addition, Andrews (2007) argues that 30% of teachers describe Mathematics as a device to facilitate learners' understanding of, or participation in, the real world, because of its relevance to everyday life. This implies that the everyday use of Mathematics is necessary for learners because it increases their confidence in their problem-solving abilities and also adds to their competence in the subject. Thus, Mathematics is part and parcel of learners' journeys to their futures. This implies that Mathematics is an important subject in the school curriculum as, globally, it is compulsory at both basic and senior secondary education levels (Ginsburg & Amit, 2008).

According to these definitions, Mathematics is an important subject of study and this highlights the importance of examining the experiences of teachers teaching fractions in Grade 6. In the USA, the concept of fractions is selected because of its importance in foundation phase Mathematics. In the third grade in both the USA and China, students are taught basic fraction concepts such as fractional units, part-whole relations, and the concept of "dividing shares evenly". A solid grasp of these basic concepts can support students' future learning of more complex fraction concepts such as raising fractions to a specific denominator, reducing fractions, adding and subtracting with like and unlike denominators, and mixed numbers and their conversion to fractions and back again. Fractions are difficult to teach and learn for both American and Chinese children (Hope & Owens, 1987; Leinhardt & Smith, 1985; Zhang, Liu & Wang, 1982). South African learners are no exception.

There is a need to understand the experiences of teachers and learners (their beliefs about pedagogy and schooling) in order to understand their method of teaching fractions. The critical challenge here concerns Mathematics and the knowledge that is needed for teaching and learning. For example, at present, we do not know much about what happens when the Mathematics language that is needed to enable learners to understand fraction concepts is not well understood. The training that is currently being provided to enable educators to implement the curriculum needs to be acknowledged. In-service teachers were not trained in the previous curriculum (Revised National Curriculum Statement or RNCS), but in September 2010 CAPS was introduced (DoE, 2010). Grade 3 teachers did not receive in-service training during 2011 (Coetzee, 2012).

Du Plessis (2013) conducted a study in 15 schools in Gauteng to explore teachers' experiences regarding in-service training towards the implementation of CAPS. Data were generated using document analysis and semi-structured interviews. The findings reveal that CAPS was implemented without proper in-service teachers' training. However, an important gap has not been recognised in either education policy or teacher education practice; this concerns preparing learners to work in a reformed curriculum that demands making connections within Mathematics and between Mathematics and other disciplines (Watanabe & Huntley, 1998). This concurs with Khoza (2015b) that teachers must make connections within Mathematics and other subjects.

Many approaches to implementing Mathematics reform concentrate on preparing teachers to implement such reforms (Pithouse, 2001). The "training" of teachers for South Africa's CAPS Mathematics curriculum is a sound example. The training of in-service teachers was short in nature (Venkat, 2013). This implies that there have been many inadequacies in implementing curricular reform. Some of this inadequacy has to do with the conceptions of curriculum that are informing curricular implementation. There is a need to think of approaches that acknowledge that, just as new curriculum proposals place heavy demands on teachers, they also place demands on learners. The dominant literature on teacher education focuses on educating teachers and preparing them to implement the requirements of a new curriculum. Given the demands that the new curriculum presents for teachers, it is important that teachers are prepared to face the demands of the new curriculum, particularly the Mathematics curriculum, and the teaching of fractions. Therefore, it is important to look at the mathematics curriculum reforms in South Africa.

2.5 Mathematics curriculum reforms in South Africa

Poor performance in Mathematics, especially in South Africa, is of great concern (Arnott et al., 1997; Peters, 2011). In 2011 the DBE released the result of the Grade 6 Systematic Evaluation, and these learners performed below the level expected of them. The results showed that Grade 6 learners are not able to count at the expected level and are also unable to execute tasks that demonstrate skills associated with numeracy (DoE, 2008). In 2008, to address poor achievement outcomes in education, then Minister of Education Naledi Pandor launched the "Foundation for Learning" campaign, which focused on the foundation and intermediate phases of education. Curriculum materials that were developed reflected an explicit approach to teacher development; clearly defining teaching objectives, materials and

learning activities per week. The campaign was introduced to improve learner performance across the curriculum, including the learning of fractions in the classroom.

The DoE set a target: by 2014, 60% of learners in Grades 3, 6 and 9 should perform at acceptable levels in Mathematics. The first three of 27 goals in Action Plan to 2014: Towards the realisation of schooling 2025 (DoE, 2010) emphasise the need to improve learner performance in Mathematics at Grade 3, 6 and 9 levels. However, despite this initiative learning, the outcome measured in 2009 was very poor. The average score obtained by learners was 35% in numeracy, demonstrating that South African learners could not compute at Grade 6 (DBE, 2010).

The aim of the DBE is to monitor learning outcomes so that support can be provided to improve the quality of teaching, learning and learning materials. Another initiative introduced by the DBE in 2011 was the Annual National Assessment (ANA) – a summative assessment of the knowledge and skills that learners are expected to have developed by the end of each of each grade (1 through to 6 and 9) in numeracy. ANAs are marked and moderated by different teachers for the Ministry of Education to evaluate education levels and note where improvement is necessary in order to meet the target of 2014 (Van Niekerk, 2012). Thus, the ANA was viewed as a key proactive intervention by government to improve the foundation skills in teaching and learning fractions (DoE, 2011).

The ANA tests written in February 2011 involved approximately almost six million learners in primary schools throughout South Africa in Grades 3 and 6 (DBE, 2011). Despite interventions by the DoE, results in Mathematics were disappointingly low – particularly in fractions. Learners' mathematical performance in public primary schools has not been noted to be improving. Mathematical competence within the ANA framework has consistently been shown at unacceptable levels. Several reasons have been advanced for this dismal performance, including that of teacher incompetence (Bloch, 2009). Mathematics is a language on its own and, while many learners have IsiZulu as their first language, mathematical assessments and instructions are written in English. That means that a learner needs to master three languages so that he or she can pass the assessment. This suggests that the language used in Mathematics assessments needs to be carefully considered.

Furthermore, Fennema and Franke (1992) have noted that teachers' knowledge of the content influences classroom instruction and the richness of learners' mathematical experiences in Grade 6. The above revelations should be looked at by curriculum experts, with the help of teachers, to tackle the problem of teachers' delivery. The prospective teachers suggested that teachers should use many strategies to help learners understand concepts before solving questions procedurally. For instance, the prospective teachers suggested visualisation through concrete materials and using examples or models from daily life, and using problem-solving strategies, in order to familiarise learners with concepts (in this case, fractions).

The prospective teachers added that these activities would encourage learners to not just memorise the multiplication rules, but to develop a deep understanding of the concepts. In addition to these strategies based on cognitive skills, the prospective teachers emphasised that, as teachers, they should focus on students' motivational needs and increase students' confidence and efficacy beliefs. That is, the prospective teachers believed that teachers should not only focus on teaching concepts to the students but also take into consideration students' emotional needs. Therefore, there is a need for discussing the challenges of Mathematics teaching in South Africa.

2.6 Challenges of teaching Mathematics in South Africa

Primary school Mathematics in South Africa has been described as being in a state of crisis (Fleisch, 2008). Therefore, the South African curriculum specified that the primary years should provide a good understanding of number sense and basic arithmetic skills (DoE, 2008). However, the studies proved that learners have not acquired those skills (Fleisch, 2008). This suggests that learners will experience problems when learning fractions in Grade 6. Spaull (2013) and Simkins (2013) draw reference to a 2013 report by the CDE, which shows that increasing indicators on school performance and teaching are revealing poor teaching of Mathematics in the majority of South African schools. This is a trend that is likely to accelerate private schooling growth and enrolment in private extra Mathematics lessons. The report cites among others, data collected in 2007, which show that the majority of Grade 6 teachers in South Africa cannot answer a question that their pupils ought to be able to answer based on the Grade 6 curriculum. Obviously, it is almost impossible to teach what you do not know. Furthermore, the World Economic Forum's *Global Information Technology Report* (2015) ranked the quality of South Africa's education system 140th out of 144 countries.

The CDE (2013) report reiterates that the teaching of Mathematics in South African schools is among the worst in the world. The TIMSS showed that South African pupils have the lowest performance among all 21 middle-income countries that participated (DBE, 2011). However, when looking at inequalities in South Africa, there is significant disparity. Although South African Mathematics teachers in quintile five (most affluent) schools can nearly compete with the average Kenyan Mathematics teacher, the bottom three quintiles (nearly two-thirds of the population – probably reflective of the average rural area, small towns and most townships) rank slightly worse than Lesotho and Zambia. Lesotho and Zambia are low-income economies, and are far from South Africa's level of economic modernisation. Most of the countries with similar results to South Africa have a much lower per-capita spending on schooling. Countries performing much better than South Africa, such as Tanzania, Uganda and Zimbabwe, have per capita gross domestic products that are only a small fraction of South Africa's and, interestingly, also have a high proportion of learners attending low-fee private schools.

These international comparisons show that South Africa is performing poorly in Mathematics but one must also look at national evaluations. The 2011 TIMSS showed that South Africa performed worse than any other middle-income country in Mathematics (Spaull, 2011). The average South African learner in senior phase is two years' learning behind the average intermediate phase learner from 21 other middle-income countries in Mathematics.

How does one make up such deficits? Teacher competency is an issue. There is also a major problem with teacher complacency, and this is linked to the ways in which many teachers are appointed – often not on merit. One aspect of this lack of attention to merit is how teachers evaluate themselves. Spaull (2013) observes: "In the 2011 TIMSS, 89% of Grade 9 teachers in South Africa felt 'very confident' in teaching mathematics". This is in stark contrast with teachers in the best performing countries: Finland (69%), Singapore (59%) and Japan (36%). This perception indicates that, in reforming Mathematics teaching, we are likely to encounter resistance from teachers. Why should they want to improve and undertake retraining, for example, if they believe they are already doing a good job? Remedial interventions will have to bear this attitudinal challenge in mind.

In addition, teachers with a positive attitude towards Mathematics are motivated to stimulate favourable attitudes in their learners (Yara, 2009). Teachers' characteristics and attitudes

have a great effect on learners' Mathematics learning, achievement, and attitudes toward Mathematics (Di Martino & Zan, 2010). This implies that teachers' attitudes towards Mathematics have a powerful influence on the formation of students' attitudes (Mensah, Okyere & Kuranchie, 2013). Di Martino and Zan (2010) say that an attitude towards Mathematics is just a positive or negative emotional character towards Mathematics. (They further state that a positive attitude means a positive emotional disposition toward the subject, and a negative attitude towards Mathematics affects various aspects of social context, for example, refusing to apply mathematical thinking.

Based on this evidence, government has important challenges in Mathematics schooling. Reform, especially in performance management, in the public sector is vital before significant improvements can be achieved. The implementation of the 1+4 teacher development plan, which is aimed at boosting performance in the senior phase, will go ahead after teachers' unions expressed support for the initiative (DBE, 2015). According to the DBE (2015) the Education Labour Relations Council, a body comprising all teacher unions, has agreed to the 1+4 programme for Mathematics teachers. This plan has been developed to address the poor performance of learners in Mathematics, as well as the levels of competency of Mathematics teachers in South African primary schools. The DBE says the 1+4 model was based on, and supports, the concept of professional learning communities, which Angie Motshekga, Minister of Basic Education, launched in August 2014. The 4+1 model works on the assumption that teachers need assistance with the entire curriculum and not just certain sections of the curriculum. "We need to be extremely radical and do the 'out of the normal' in our determination to save our children" (DBE, 2015). However, understanding the concept fractions is important for this study.

2.7 The concept of fractions

The concept of "fractions" can be defined in several ways. According to Kong (2008), a fraction is an object that has multiple meanings and representations. Kong explains that a fraction is represented by a*/b* where *a* and *b* are integers and *b* is non-zero, and that the concept of fractions can be interpreted five ways: part-whole, measure, operator, ratio and quotient. "Part-whole" describes the relation of a part of a quantity to its total amount (Lee, 2012). For example, in the fraction 3/5, the numeral 5 shows how many parts it is divided into and the numeral 3 shows how many fifths (pieces) are taken. The concept "fraction" refers to common fractions and not related concepts in working with decimals, percentages,

ratios or proportions (Misquitta, 2011). “Common fractions” are quantities that can be represented as a fractions of integers for example 3/4 (Gabriel et al., 2012). Russell (2007) explains fractions as a part of a whole. Pienaar (2014) defines a fraction as “a number that expresses part of whole as a quotient of integers (where the denominator is not zero)”. Russell further states that another way to describe a fraction is “a division expression where either the dividend or top number is not zero”. A fraction can also be defined as a part of a whole, a place on the number line, an answer to a division calculation, or a way of comparing two sets or measure (Kleve, 2009).

According to Jordan, Hansen, Fuchs, Siegler, Gersten and Micklos (2013) fraction concepts include understanding that fractions represent parts of an object or part of a set of objects. They also point out that fractions can be represented by fraction symbols, for example 1/3, and that fractions are numbers that reflect magnitudes (for example, 2/5, 2/4 and 2/3) can be ranked from smallest to largest. In contrast, Pantziara and Philippou (2012) argue that “fraction” refers to its multidimensional constructs, namely part-whole, ratio, quotient and operator. For example, the fraction 3/4 can be conceived as a part of a whole (three out of four equal parts), as a quotient (three divided by four), an operator (three-quarters of a quantity), a ratio three parts of four parts and finally a measure (as a part on a number line). Toluk-Uçar (2009) argues that fractions are used to represent part-whole relationships. Toluk-Uçar further states that fractions are fundamental to measuring continuous quantities, that they are involved where quantities are divided, and they are used on multiplicative comparisons of two quantities. Furthermore, Wu (2011) argues that a fraction is presented as three things at all once: it is a part of a whole, it is a ratio, and it is a division. Thus, 3/4 is three parts when the whole is divided into four equal parts.

The definition of fractions used in this study is taken from Misquitta (2011), in which “fraction” refers to common fractions and not related concepts in working with decimals, percentages, ratios or proportions. Looking at the above definitions, it is evident that most teachers find it difficult to teach fractions as the learners also struggle to understand the concepts, especially at Grade 6 level. Furthermore, this implies that the teaching of fractions is complicated for teachers to interpret and then teach.

It is evident that the teaching of fractions is problematic. Moreover, this suggests that the learning of fractions is also problematic. According to Lamon (2007) teaching and learning

fractions is most the challenging aspect of the school mathematics curriculum. Young-Loveridge, Taylor, Hàwera and Sharma (2006) conducted a study in six intermediate-phase schools. Participants were 238 intermediate learners, aged between seven and eight. Participants were given a task that involved addition with fractions. The findings showed that only 32 learners found the correct answer for the problem. Some of those who managed to solve it used procedural knowledge instead of a deep understanding of fractions. The findings indicated that, generally, learners' knowledge of fractions is limited and only few learners have a deep understanding of fractions.

Harvey (2012) investigated the fraction content knowledge of prospective teachers in New Zealand and their ability to use this knowledge in an original situation. The findings showed that this knowledge was weak, which implies that the teachers will encounter problems when teaching fractions. Ma (1999) argues that the generally low quality of Mathematics education in the USA contributes to the low quality of teachers' knowledge of school Mathematics there. Unfortunately, teachers who do not acquire mathematical competency during schooling are unlikely to have another opportunity to acquire it. Most teacher preparation programmes in the USA focus on how to teach Mathematics rather than on the Mathematics itself (National Centre for Research on Teacher Education, 1991). Later, when they become teachers, they typically do not have the opportunity to improve their knowledge of the subject matter.

Wilson, Shulman and Richert (1987) observed that teachers who had more subject matter knowledge were more likely to: notice misleading or poorly articulated themes in the textbook; detect misconceptions; utilise opportunities to ''digress'' into other discipline-related avenues: deal effectively with general class difficulties in the content area; and correctly interpret students' insightful comments. However, in South Africa, many Mathematics teachers struggle with the content that they teach (Bansilal et al., 2014). This concurs with Shulman's (1986) finding that the limited mathematical knowledge of teachers is problematic when it comes to teaching Mathematics.

Many studies on primary school Mathematics teachers' content knowledge have been undertaken (Hugo, Wedekind & Wilson, 2010; Spaull, 2011). Hugo et al. (2010) conducted a study of teaching and learning Mathematics in primary schools in KZN. The participants were teachers and learners. The findings showed that none of the teachers was able to get

100% for a test on the curriculum that they were teaching. In addition, 24% of respondents got less than 50% and, on average, only 47% managed to get test answers correct. Fractions were no exception.

On the other hand, Spaull (2011) analyses the SACMEQ findings, showing that 5% of Grade 6 learners scored higher marks on the same Mathematics test than the bottom 12.5% of Grade 6 teachers in the sample.

Moreover, even when students seem to understand the rote procedures needed to manipulate the symbols, they soon forget the procedures and thus find it difficult to learn how to operate fractions and rational numbers. To improve instruction, Mathematics teachers need to challenge and support students, and have a sound understanding of the gap between what students know and what they need to learn about fractions. Furthermore, effective teachers should know the concepts and topics that students often have difficulty with, as well as ways to clarify students' common misunderstandings (National Council of Teachers of Mathematics, 2000). In fact, many studies that concentrate on the teacher's role in increasing the effectiveness of instruction emphasise the importance of the teacher's knowledge of related content areas as a major determinant of Mathematics instruction and learning (Ball 1990; Crespo & Nicol 2006; Hill, Rowan & Ball, 2005; Tirosh, 2000).

It is believed that teachers should understand fraction operations conceptually in order to help learners develop ideas of fractional mathematical concepts (McDiarmid & Wilson, 1991). However, many research studies suggest that teachers themselves may have several misconceptions about the meaning of multiplication and division concepts, as well as about the relationship between multiplication and division (Azim 1995; Borko, Eisenhart, Brown, Underhill, Jones & Agard, 1992; Simon & Blume 1994; Tirosh 2000). For instance, in a study of prospective elementary school teachers in an American university, Azim (1995) reported that 56% of the prospective teachers attended the method course without a way to reason about the multiplication of fractions less than one. Thus, it is important to investigate teachers' knowledge of fractions including operations with fractions. In a more recent study, Izsák (2008) emphasised that research studies on teachers' knowledge of fractions mostly focus on fraction division and decimal multiplication rather than fraction multiplication. Furthermore, Clarke, Clarke and Roche (2011) encourage teachers to place a greater emphasis on the numerous meanings of fractions to improve learners' understanding of

fractions. This implies that using a single meaning of fraction will hamper learners' deep understanding of fractions and meaningful fractional computations.

Good teaching demands that teachers know many things: about teaching; about their students; and about the cultural, political, and social context within which they work (Ball & McDiarmid 1990). Teachers who understand the concepts should be able to answer students' questions about the meaning behind their symbolic manipulations, explain why certain procedures work and some do not, and address the relationship between concepts (Borko & Putnam 1996). On the other hand, less knowledgeable teachers tend to emphasise facts, rules and procedures, and depend strictly on their lesson plans. Nevertheless, subject matter knowledge alone is not enough to achieve this goal. Teachers should also transform the content into representations that help learners to develop an understanding of fractions (Shulman, 1986).

2.8 Conceptual framework

A conceptual framework is defined as a network or a plane of linked concepts (Jarabeen, 2009). The conceptual framework that underpins this study is framed by a curricular spider-web of (Van den Akker et al., 2009), according to which, a curricular spider-web can be divided into 10 concepts that speak to specific elements of the teaching process: rationale; aims and objectives; content; teaching activities; the teacher's role; material and resources; grouping; time; location; and assessment.

2.8.1 Rationale of teaching fractions

The rationale is the major guiding component, while the other nine components listed above are ideally linked to the rationale and also consistent with each other. Van den Akker et al. (2009) stress the importance of the consistency of the curriculum components in the drawing of a curricular spider-web. The rationale is important because it is the link that connects all other curriculum components of this spider-web. Rationale is described as "the reply to the question why a subject is taught at school" (Van den Akker et al., 2009). This suggests that teachers teaching fractions in Grade 6 should have a rationale for teaching. Berkvens, Van den Akker and Brugman (2014) state that the rationale for teaching should be based on three rationales: personal; societal; and content knowledge.

All teachers have a personal rationale for teaching. Khoza (2015b) conducted an interpretive case study on two groups of students and a facilitator to establish why the facilitators facilitated the module. Data were generated using document analysis and semi-structured interviews. The findings revealed that one of the reasons that the facilitators facilitated the module was that they wanted to change the students' understanding from pre- to post-research. These findings are common to those of Khoza (2014), in that the rationale for facilitating the research module can be seen from the perspectives of the facilitator or the student. This suggests that personal experiences can play an important role in teachers' rationales when teaching fractions in Grade 6.

Hunter (2010) states that the personal rationale is what makes a successful teacher and guides him or her to do what needs to be done differently in order to prepare students for the 21st century. The personal rationale encourages teachers to expand their mathematical knowledge in order to teach fractions effectively (Ball, Bass, Hill & Schilling, 2005). This suggests that teachers' mathematical knowledge must become part and parcel of their everyday practices (Ball, Thames & Phelps, 2008). The personal rationale appears as the most influential in driving teachers to teach fractions.

According to the Ministry of Education (1992), learners need to be taught Mathematics in a meaningful way so that they will see its relevance to everyday transactions and other meaningful contexts. On the other hand, Gutstein (2012) asserts that Mathematics should be a vehicle for learners to deepen their grasp of the socio-political contexts (the societal rationale) of their lives, through the process of studying their realities. This suggests that Mathematics is important for learners in understanding their socio-political contexts. Gutstein (2003) conducted a qualitative study on teaching and learning Mathematics in an urban Latino school with respect to social justice and the role of the standards-based curriculum of the National Council of Teachers of Mathematics (NTCM). The findings revealed that students had begun to read their world (understand complex issues involving justice and equity) which helped them to develop mathematical power and change their orientation towards Mathematics.

A qualitative study conducted by Esposito and Swain (2009) examined the ways in which urban teachers used culturally relevant pedagogy as a mechanism for teaching Mathematics.

The findings revealed that Mathematics helped learners to think critically about how social injustices affected their lives.

Another qualitative study (Tella, 2008) indicated that an individual could function well in society if he or she has a relatively good knowledge of fractions, especially in the technological age. The above studies suggest that teachers teach because of societal rationales, and that they want to contribute to their communities. Tella (2008) concluded that Mathematics is the basis of all sciences and the technology of all human activities. This suggests that the teachers' self-efficacy and interest correlated significantly with learners' scores in fractions.

Ball et al. (2005) stated that to implement curriculums, school systems depend upon the work of skilled teachers who understand the subject matter. This suggests that teachers who are teaching Mathematics should be qualified and knowledgeable about fractions. Therefore, teachers who are teaching fractional content, are teaching because they want to impart some skills to learners. These teachers also want to attain aims stated by the curriculum because they are qualified to teach. This indicates that teachers are teaching because they are qualified to teach mathematics. However, studies examining prospective teachers' knowledge have found that many possess a limited knowledge of Mathematics in key content areas such as fractions (Tobias, 2013). One example is a study conducted by Young and Zientek (2011) on prospective teachers' competency with and confidence in fractions. They found that the level of competence in prospective teachers varies by fraction operation. This means that many prospective teachers inaccurately predict their performance when multiplying fractions with prime denominators and dividing reciprocal fractions. In essence, it means that the knowledge of prospective and in-service teachers with regard to fractions is limited (Ma, 1999; Newton, 2008).

Pienaar (2014) argues that fractions play an important role in our ever-advancing technological society, and that many occupations today rely heavily on the ability to compute fractions accurately, proficiently and insightfully. Furthermore, fractions are essential foundation skills for future Mathematics success (National Mathematic Advisory Panel (NMAP), 2008). In addition, Jordan et al. (2013) assert that fractions are important for daily functions such as managing personal finances and doing home repairs.

Nasier, Wright and Capraro (2004) say that learners need to be more strongly involved in the learning of fractions. Teachers can involve learners in the learning of fractions by showing them how fractions apply to real-life situations. Teachers should not neglect fractions. This suggests that teachers have many rationales for teaching fractions and thus the rationale for researching teachers' experiences of teaching fractions in Grade 6 is established.

It is also important to note that CAPS (2011) does not define the rationale for teachers who are teaching mathematics. As CAPS is the intended curriculum this suggests that CAPS concurs with (1949) product-based approach to curriculum, in which the focus is on high levels of understanding of the subject.

While the above studies state different rationales for teaching, none of them have looked at teachers' experiences of teaching fractions in Grade 6. This suggests that there is a need for a study of this nature within the interpretive paradigm. This study should use reflective activity, semi-structured interviews and focus group interviews as data-generation methods.

2.8.2 Goals towards which teachers are teaching: Aims, objectives and learning outcomes

According to Kennedy, Hyland and Ryan (2006) and Khoza (2013), aims are broad statements of teaching purpose and are written from a teacher's point of view. These authors further explain that aims are written to show the general content and direction of a lesson, while objectives are specific statements of teaching purpose and are written to show one specific area that the teacher intends to have covered by the end of the lesson. On the other hand, Berkvens et al. (2014) indicated that aims and objectives in education could monitor decisions on the content of subjects, which need to reproduce the subject knowledge that is important to the core of subject.

The importance of aims in the implementation of the curriculum has been emphasised by (Khoza, 2015a), who considers that the aims dictate the purpose of subjects like mathematics. This indicates that the way the subject is taught is dependent on the stated aims of the subject. According to CAPS (2011) aims are called "general aims" and the objectives are called "specific aims". However, aims and/or objectives as specified in Mathematics documents are general aims of the planned curriculum and the implemented curriculum. These aims and/or objectives are not specific to the teacher's intention when teaching a certain topic or content.

For example, the CAPS document does not state specific aims for any teacher of fractional concepts.

Harden (2002) and Rauhvargers, Deane and Pauwels (2009) state that learning outcomes are statements of what the learner will know, understand and be able to demonstrate after the completion of a programme of learning). Redmond (2007) argues that learning outcomes describe actions or outcomes that are demonstrable and assessable. This implies that the skills and knowledge that a learner can prove to have acquired after completing a learning programme can be identified, which in turn suggests that Mathematics teachers cannot teach fractions without any pre-specified learning outcomes. Moreover, O'Brien and Brancaleone (2011) argue that learning outcomes are classified in accordance with Bloom's taxonomy (1956), specifically listing six categories of learning: knowledge; comprehension; application; analysis; synthesis; and evaluation. This suggests that understanding the formulation of learning outcomes might assist teachers to teach fractions in Grade 6.

The intended learning outcomes are not clearly stated in CAPS but, looking closely at the specific skills, one may notice that learning outcomes include some specific skills. The specific skills in CAPS provide a ready-made structure and follow the list of verbs used in Bloom's taxonomy. However, Khoza (2013) suggests that learning outcomes need to be observable and measurable in order to guide teachers on objectively measuring their students' performance. This concurs with Adam (2004) in that a course must have observable and measurable learning outcomes in order to achieve consistency of delivery, transparency and clear information. This suggests that all subjects should have learning outcomes in order to assist learners in terms of procedures.

In conclusion, Berkvens et al. (2014) are of the opinion that aims and objectives of a course must outline three perspectives: student (creating job opportunities and building self-esteem); society (knowing the value of society); and subject (understanding how mathematics is taught). The specific and general aims of CAPS are relevant because they address all the above-mentioned perspectives. While there are no stated learning outcomes in CAPS, specific skills are highlighted and this may cause confusion to teachers who are teaching Grade 6 fractions. However, the way to attain the aims and objectives is explained by the content of the curriculum. One may conclude that CAPS leaves teachers with no choice but to use their discretion when deciding how to teach fractions in their Grade 6 class.

2.8.3 Content that is being taught in fractions

According to Bush, Kiggundu and Moorosi (2011), content is defined as the teaching material of the course, on behalf of the curriculum. The DBE (2011) says that content is the CAPS for the intermediate phase. Collocott, Gerrard and Maharaj (2013) state that Mathematics content has five main content areas: numbers; operations and relationships; patterns; functions; and algebra, space and shape (geometry), measurement and data handling. However, as with other content areas, learning fractions progresses annually with an increase in number ranges, as well as changes in calculation techniques. According to the benchmark outlined by the NMAP (2008), learners should be capable of identifying and presenting fractions by the end of Grade 4, of comparing magnitudes of fractions by the end of Grade 5, of multiplication and division of fractions by the end of Grade 6, and of all operations with positive and negative fractions by the end of Grade 7. This suggests that teachers must know all the yardsticks in order to teach fractions productively.

Furthermore, most Mathematics teaching in New Zealand is guided by a national curriculum statement (New Zealand Ministry of Education, 1993). In this document, Mathematics is one of the eight specified learning areas (Crooks, 2010) and has three strands: numbers and algebra; geometry; and measurement and statistics. Western Australia's curriculum framework (Curriculum Council, 1998) articulated seven components in the learning area of mathematics: appreciating mathematics; working mathematically; numbers; measurement; chance and data; space; and algebra. The topic of fractions is placed in the "numbers" strand. This placement is identical to South Africa's Placement of fractions. South Africa's Outcomes-Based Education (OBE) plan did not have a supplementary syllabus document but it created guidelines that defined what learners should know. Thus, the teaching of fractions is problematic and frustrating for many educators as their understanding of the topic is not well developed (Nasier, Wright & Capraro, 2004). This implies that possessing content knowledge of Mathematics is important for improving the quality of instruction (Hill & Ball, 2004). Teachers often lack a deep conceptual understanding of Mathematics (Ma, 1999). A study conducted by Johnson (1998) acknowledged some misconceptions held by prospective elementary school teachers, which include the beliefs that a fraction having a big denominator is always big and that two fractions are almost equal. This shows that many teachers do not have a profound conceptual understanding of Mathematics in general, and it is possible that their conceptual understanding of fractions would also be deficient.

Mathematical knowledge is important for the effective teaching and learning of Mathematics, and teachers who lack subject-specific knowledge will be less effective (Cobb & Jackson, 2011). A deficiency in mathematical knowledge for teaching Mathematics (MKT) in Mathematics teachers has been identified in New Zealand-based research (Harvey, 2012). MKT is defined as "the mathematical knowledge used to carry out the work of teaching mathematics" (Hill et al., 2005). Ward (2010) studied teachers in New Zealand to determine their MKT relating to fractions. The participants were 78 primary school teachers of years 1 to 9. The teachers has to answer questions that tested concepts to be taught to learners between the ages of 7 and 10. The findings show that the teachers' MKT relating to fractions was limited. Teachers must understand their own difficulties with fractions before being able to supplement the teaching of fractions (Pienaar, 2014). Thus, any incorrect teaching of fractions can affect learners' understanding of the topic (Thambi & Eu, 2013).

Furthermore, many curriculum developments present the school Mathematics curriculum as lists of topics or concepts (Anderson, 2009). The Australian Mathematics curriculum stresses the importance of understanding, fluency, problem solving and reasoning, as important elements that interact with the content strands (Australian Curriculum Assessment and Reporting Authority (ACARA), 2011). The curriculum document notes that in years 3 to 6, learners "need active experiences that allow them to construct key mathematical ideas, pictures and symbols to represent these ideas" (ACARA, 2011). In 2011, the Mathematics curriculum in Australian presented three content strands: number and algebra; measurement and geometry; and statistics. Kilpatrick, Swafford and Findell (2001) identified four strands (proficiencies) to teach the Australian learners: understanding; fluency; problem solving; and reasoning. The Australian Mathematics curriculum encourages teachers to consider seriously these four proficiencies (Clarke, Clarke & Sullivan, 2012). This suggests that teachers have a responsibility to master these topics and must teach these proficiencies equally. Furthermore, ACARA (2011) states that the Australian Mathematics curriculum asserts that these proficiencies will identify the skills, behaviours and attributes that students need to succeed in life. Thus, the Australian Mathematics curriculum is the vision for educating young Australians for the 21st century (Atweh & Goos, 2011). This is similar to New Zealand, in that the focus is on increased learner-centred and conceptually focused Mathematics teaching (Hunter, 2010).

In addition to the above, Pienaar (2014) states that teachers must be able to improve their instruction of fractions and broaden their own understanding because fractions are difficult. This means that teachers must understand the complexities of fractions themselves. Ball et al. (2008) argue that background, experiences and content knowledge are crucial for teachers to draw upon when presenting a topic like fractions in the classroom. This suggests that content knowledge and experiences might help teachers to teach fractions.

Further, the NMAP (2008) recommends that developing conceptual and procedural knowledge is important if one is to master fractions. "Conceptual knowledge" refers to creating links between discrete pieces of knowledge, linking information to previous knowledge and recognising relationships and commonalities among different pieces of information (Miller & Hudson, 2007). Further, conceptual knowledge of fractions includes comparing and judging the magnitudes of fractions, understanding fraction representation, and determining fraction equivalence (NMAP, 2008). In addition, Miller and Hudson (2007) assert that "procedural knowledge" is the ability to follow sequential steps to solve a mathematical task. This implies that if teachers have a rich teaching knowledge about fractions, the concept of fractions can be taught more meaningfully.

Carnoy, Chisholm and Chilisa (2012) found some evidence to suggest that teachers with good mathematical knowledge taught Mathematics more effectively, and were likely to spend more time teaching fractions in Grade 6. In addition, these teachers produced better learner results overall because of the strategies they used. Moreover, Hoadley and Jansen (2013) state that the teacher must know all the topics of the subject. This suggests that the teachers must possess subject knowledge in order to teach fractions effectively. However, teaching the content can also be affected by teaching activities that determine teaching and learning.

2.8.4 Teaching activities when teaching fractions

Teaching activities are activities designed or deployed by the teacher to bring about the conditions of teaching (Morgan, 2010). On the other hand, Berkvens et al. (2014) state that, in order to be consistent, learning activities must be in line with the vision on education and the overarching goals and objectives. They further state that learning, and teaching and learning materials, can be used for prolonged periods to demonstrate sustainability. In addition, Van den Akker et al. (2009) argue that, at classroom level, it is important to consider the best activities for attaining the subject aim, because this cannot be considered at

the macro level. This suggests that teachers must choose the activities that take learners through fractions in order to attain the subject aims.

However, Bennie and Newstead (1999) state that mathematics requires problem-solving activities, which challenge the ability of the learner to understand Mathematics. Teaching activities are not specified in CAPS; instead teachers are given topics to cover every week. This suggests that teachers decide on the activities after looking at the topic. Hoadley and Jansen (2013) state that the adopted curriculum approach will determine whether or not the activities are learner- or subject-centred. Therefore, different teachers use different teaching activities because learners are different in their ability to grasp fractions. The classroom organisation and instructional management should cater for both academic and behavioural aspects of teaching and learning (Dotterer & Lowe, 2011).

However, Coetzee (2009) states that the teaching method applied in the classroom involves all learners in challenging activities. Harris and Hofer (2011) argue that using hands-on activities helps teachers make lessons interesting and fun. Long (2004) concluded that hands-on activities are good for both teachers and learners. This suggests that the application of knowledge in some learner activities forms the basis of active learning when learning fractions.

Qazi and Rawat (2014) conducted a mixed-method study on 14 male and 16 female teachers, aimed at facilitating the translation of the concept of fractions using learner-centred activities. Data were generated using pre-test, post-test and semi-structured interviews. The findings revealed that the teaching of fractions via a learner-centred activity approach yielded good results. This suggests that teachers should use learner-centred activities when teaching fractions in Grade 6. Cohrssen, Church and Tayler (2014) conducted a study on Australian learners using play-based Mathematics activities. The data were generated using video. Transcriptions of interactions during the activities demonstrated that, when teachers paused prior to responding to children or after children have responded, their responses were more sensitively attuned to the children's contributions. Moreover, Cavanagh (2011) also conducted a study on students' experiences of lectures, which included many opportunities for active engagement through co-operative learning activities. The participants were 113 students. The data were generated using a questionnaire. The results indicated that students

valued a mix of traditional lecturing and co-operative tasks, particularly a variety of activities for small-group and whole-class discussions.

Khoza (2015b) conducted a study on teachers' reflections on their CAPS experiences. Data-generation methods included project analysis, semi-structured interviews and focus group interviews. The findings showed that the participants' activities were linked to the content, and there are no learning outcomes specified in CAPS for the subject. This suggests that learning activities are important when teaching fractions in Grade 6. According to Khoza (2013) the lectures should use genuine activities that link students to real-life situations. This suggests that teachers teaching fractions in Grade 6 must link their activities to real-life situations. Learners need to be taught using what is known from their cultural backgrounds and environments (Zulu, 2013).

Moreover, Liodaki and Karalis (2013) conducted a study to explore the educational experiences of students. The participants were 417 undergraduates in Greece. The data were generated using a questionnaire and a semi-structured interview. The results showed that the learning activities contributed to a large degree to changes to the personal lives of the students during the course of their studies. The above studies on the teaching activities were conducted using the mixed-method and qualitative approaches.

None of the above studies have looked at the teachers' experiences of teaching fractions in Grade 6. This shows that there is a need for a study that uses reflective activity, semi-structured interviews and focus group interviews as data-generation methods. Teachers must understand their roles when using the activities.

2.8.5 The role of the teacher when facilitating fractions

According to Hoadley and Jansen (2013), the role of the teacher in the curriculum is determined by a teacher-centred (instructor), learner-centred (facilitator) and content-centred approach. This concurs with Khoza (2013) in that teachers must choose a relevant role in order to implement the curriculum. This suggests that teachers must know these roles in order to teach fractions in Grade 6. Landsberg (2005) states that a teacher is a facilitator (is learner-centred) who creates a classroom environment that is full of opportunities for learners to make sense of the knowledge, skills and values to be learnt. On the other hand, Jacobson and Ruddy (2004) state that a facilitator must demonstrate genuine interest in the learners and

their learning, so that meaningful learning occurs. Learner-centred education suggests that humans learn by actively constructing and assimilating knowledge rather than by passively adding discrete facts to an existing store of knowledge (Kouwenhoven, 2010; Hardman, Abd-Kadir & Smith, 2008). In addition, De Vries (2014) defines "facilitation" as developing knowledge and understanding in a learner whereby the communication is in the method and not the content. This suggests that the teachers are using learning outcomes to drive their lessons.

According to Hoadley and Jansen (2013), the performance approach that is driven by aims and objectives urges a teacher-centred role. On the other hand, O'Neill and McMahon (2005) state that the teacher-centred approach focuses on the teacher transmitting knowledge, from the expert to the novice. This suggests that the teacher is the only person who knows all. It also means that teachers are encouraging the acquisition of knowledge. Therefore, it implies that teachers have control over the learners and the classroom activities. However, Sabzian, Ismail, Ismail and Vajargah (2013) argue that the role of the teacher as the exclusive holder of expert knowledge (a teacher-centred definition) is being worn away by communication technologies. Moreover, Hoadley and Jansen (2013) assert that the role of the teacher is driven by the approach that is adopted by the teacher. Carl (2010) states that there are seven roles for teachers: mediator; interpreter; assessor; researcher; designer of learning materials, resources and programmes; leader; and manager and administrator.

When teachers favour content to drive their lessons it means that their role is content-centred. Kember and Kwan (2002) conducted a study to describe the alternative approaches to lecturing at university. The participants were 17 lecturers from three universities. Data were generated using semi-structured interviews. The findings revealed that the lecturers who perceived teaching as transmitting knowledge were likely to use a content-centred approach. This suggests that the teachers are concentrating on the content of teaching and on what they do while teaching. This concurs with Khoza (2013), who argues that if teachers use content to drive their lessons, then these teachers are using a content-centred approach. This suggests that teachers should choose the relevant approach to position their teaching role when teaching fractions.

However, CAPS does not specify where teachers should base their roles when teaching mathematics. This suggests that the approach (learner-centred, teacher-centred or content-

centred) that the teachers must use when teaching is not clearly defined. Therefore, it can mean that the teachers' creativity and ability to think outside the box will be an added advantage to their success in the classroom. It also means that teachers may use teaching time to engage learners in learner-centred activities using the CAPS document. This suggests that teaching activities require the resources that will suit the teaching environment and enhance the learners' achievements. Teachers must therefore know which resources to use when teaching fractions.

2.8.6 Resources for teaching fractions

"A resource is any person or thing that communicates learning" (Khoza, 2012). On the other hand, Rammapudi (2010) defines a resource as a teaching material that is used to plan a lesson, which brings the subject's content to the fore. This suggests that teachers teaching fractions must understand the issue of resources in education. Khoza (2013) conducted a case study with eight postgraduate students who used online resources while learning a curriculum module at a South African university. The data were generated using online document analysis, observation and semi-structured interviews. Khoza (2013) states that online teaching, and resources like off-line teaching and off-line learning resources, are divided into Technology in Education (TiE) and Technology of Education (ToE). He further stated that TiE comprises any teaching and learning resource one can see and touch, while. ToE is any teaching and learning resource one cannot see and touch. In addition, TiE is divided into hardware and software while ToE is known as ideological-ware. The findings reveal that learning was promoted and that teachers used textbooks, calculators, the chalkboard and workbooks to teach Mathematics. This concurs with Jansen (2009) in that a curriculum demands more resources such as textbooks, stationery, wall charts and photocopies. This suggests that teachers must use hardware, software and ideological-ware resources when teaching fractions.

In addition, hardware and software resources play a measured role in the teaching of fractions. This indicates that school principals should provide hardware and software resources for teachers to use for the implementation of the Mathematics curriculum. However, Prinsloo (2007) argues that lack of resources is one of the major barriers to the smooth implementation of curriculum in South Africa. Moreover, teachers must have lesson materials and resources when implementing the curriculum (Van den Akker et al., 2009). In addition, Martinie (2005) asserts that the primary instructional approach for teaching

fractions is textbooks. This suggests that teachers should use textbooks to teach fractions. This is supported by Remillard and Heck (2014), who say that textbooks are the most common teaching resource used throughout the world. Kelly (2009) supports the importance of textbooks in determining the knowledge that the curriculum aims to convey.

The illustration of concepts in textbooks comprises the use of drawings and pictures. However, Smith (2000) states that drawings do not speak for themselves in a textbook. In addition, Hurrel (2013) asserts that constructivism is the favourite epistemology for teaching Mathematics in Australian schools. Therefore, textbooks cannot accommodate constructivist concepts on learning, and concrete illustrations cannot be developed in the required concepts. This implies that, in order for learners to understand fractions, concrete manipulative material for supporting learners' Mathematics are appreciated (Pape & Tchoshanov, 2001). In addition, Swan and Marshall (2010) state that manipulative material includes "any object that can be handled by an individual in a sensory manner, to foster conscious and unconscious mathematics thinking". This suggests that teachers in Australia and New Zealand are using concrete manipulative materials to teach fractions. It shows that this approach will help learners to see that their learning is not restricted to rules and procedural computation.

However, Mdluli (2014) argues that resources alone may not lead to improved learner performances. Therefore, teacher methodology is crucial in influencing positive attitude to learners in the classroom. Mdluli (2014) conducted a case study on the use of DBE workbooks by six Grade 3 teachers. The data were generated using classroom observation and interviews. The key finding was that teachers used the workbooks in disparate ways, and that the majority of the teachers in the case study used the workbooks in ways that did not resonate with the DBE's intentions. Mdluli further stated that when choosing a resource it is crucial that teachers make pedagogical decisions regarding their choice of a particular resource at a particular time, and also around how they plan to use this resource to help learners to make sense of the material. In addition, Spaull (2013) says that teachers should know that workbooks contain the curriculum in weekly segments, thus enabling them to cover the full curriculum.

In addition, Yang (2009) asserts that Internet-based learning systems are becoming essential in creating interaction and communication between teachers and student. Yang (2009) used blogs to enhance critical reflection and community of practice. The participants were 43

student teachers in Taiwan. The data were generated using the student teachers' reflective experiences, group reflective dialogues, and questionnaires. The results showed that the student teachers actively discussed teaching theories and their implications on blogs. The study gathered information using observation, document analysis, workbooks, and blogs. It showed that there is a need for a study of the intermediate phase, using semi-structured and focus group interviews.

Van den Akker et al. (2009) state that resources are mainly thought of at the micro (school) level of curriculum development, where teachers choose which materials to use and where to use them. This suggests that curriculum developers at the micro level are silent on the issue of resources. As a result, CAPS does not specify which textbooks must be used in the classroom when implementing the intended curriculum. However, teachers must use CAPS-approved textbooks when teaching fractions in Grade 6. The most recent findings in terms of teaching fractions, as per the literature reviewed, is that of resources in the classroom (Empson, 2003). Lam and Lidstone (2001) are of the opinion that traditional ways of teaching are still prominent in Mathematics classrooms. This means that Mathematics teachers in some schools still prefer to use, for example, textbooks when teaching (Alajmi, 2012). As stated by Taylor (2008), textbooks "greatly assist the teacher not only with daily lesson planning, but also to achieve curriculum coverage". This may be valid; however, it may similarly prove to be a great problem as depending on textbooks is common practice among inexperienced teachers, and teachers who have little time to prepare lesson plans (Empson, 2003), meaning that these teachers are not providing the best learning experience.

2.8.7 Who is learning fractions?

Collins and O'Brien (2011) state that grouping can be either homogeneous (learners of similar abilities being placed together) or heterogeneous (learners of mixed abilities being placed together). This suggests that teachers can group learners either homogeneously or heterogeneously when teaching fractions. A quantitative study on the 16 third-graders was conducted by Thomas and Feng (2014) and presented at the Georgia Educational Research Association's annual conference. The purpose of the study was to examine the effects of homogeneous and heterogeneous groupings on the mathematical achievement of learners in third grade. To collect data, the researchers arrived at pre- and post-test assessments using a common formative assessment test. The results indicated that there was no statistical significant difference between the homogeneous and heterogeneous groupings on the

students' mathematical performance. This suggests that teachers can use both grouping types when teaching fractions.

In addition, Rytivaara (2011) conducted an ethnographic study to examine the practice of flexible grouping as a classroom management strategy. The study was conducted in a medium-sized primary school in a suburban area of Finland. The participants were two teachers of the combined classroom. The data were generated by using observation and interviews. The results revealed that, at the classroom level, the teachers used different grouping activities as part of their classroom management strategies. According to Darling-Hammond and Bransford (2005), teaching includes many simultaneous goals. It is enacted in relation to a diverse group of learners; and it requires that many kinds of knowledge be integrated. It is evident from this that, without having proper knowledge on how to engage with the teaching of fractions, nor having the necessary pedagogical knowledge of, for example, the Mathematics learning area, teachers cannot be expected to teach consistently in an integrated manner.

According to Berkvens et al. (2014), children should have access to education irrespective of their ethnicity, socio-economic status or gender. They further stated that accessibility to education depends on many aspects: the physical (is it possible to reach a school?); the financial (is the education affordable?); and the cultural (is the programme socially acceptable?). In addition, access to education is a social citizenship right that is intended to afford members of a society an opportunity to share in a basic level of social, economic and cultural wellbeing, and to mitigate inequalities (Cohen, 2010). The CAPS document prescribes the intended curriculum for all South African learners. All schools in South Africa must offer a Mathematics curriculum. This means that all South African learners can learn mathematics, irrespective of their culture.

In South Africa most public schools are "no fee" schools. All schools are divided into national quintiles using a score based on the poverty of the surrounding community. The poorest two quintiles of schools were declared "no fee" schools. This "no fee" programme has led to an increase in enrolment in South African schools (Borkum, 2012). This suggests that free education causes overcrowded classes. Teachers cannot practically implement the fractions curriculum due to overcrowded classrooms. Kahn and Iqbal (2012) conducted a study in 20 government schools to ascertain the most serious problems faced by teachers of

overcrowded classes. The participants were 40 teachers. Data were generated by using questionnaires and studies of documents and books. The findings revealed that the majority of the teachers were facing instructional and disciplinary problems.

2.8.8 Time and location for teaching fractions

Time and location are different concepts in the curricular spider-web (Van den Akker et al., 2009). However, time and location are one concept for the purposes of this study. Fraser (2012) defines the learning environment as the social, psychological and pedagogical context in which learning occurs. The study further states that the classroom environment is defined in terms of the shared perceptions of the teachers and learners, and has the double advantage of characterising the setting through the eyes of the participants themselves. Van den Akker et al. (2009) state that teaching may take place anywhere inside the school buildings. This suggests that "location" is the place where teaching takes place. The CAPS document does not specify the location for lessons, but the teaching and learning of fractions usually occurs in a classroom. Grade 6 teachers are teaching fractions in classrooms. Kember and Leung (2009) argue that the teaching and learning environment is important in the development of basic competencies. They further stated that the teaching and learning environment gives useful feedback to department heads about teaching and curriculum design. This suggests that teachers must make their classrooms conducive for teaching and learning fractions.

According to DBE (2011), the instructional (teaching) time for fractions in the intermediate phase for terms one and two is 20 hours, and for terms three and four is 10 hours. Msibi and Mchunu (2013) concur, asserting that CAPS spells out exactly what teachers need to cover in each term and specifies the number of weeks allocated for each topic. This indicates that CAPS allows for far less choice on the part of teachers in terms of what to teach, and when, and how long to spend on different topics. Taylor (2008) argues that teachers need to devote time and energy to get to know each student individually and understand their individual preferences and perceptual backgrounds. However, CAPS specifies content, knowledge and skills that are to be taught with explicit sequencing and pacing (DBE, 2011). In many cases the teaching time allocated to a curriculum is not long enough for teachers to fully address the educational material of the course. This denotes that CAPS is relevant but does not say anything concerning the environment. The CAPS document is not consistent as it prescribes the time but does not specify the location. This means that CAPS is not sustainable, as it

prescribes without considering the location, and it also infringes on and controls the teachers' professional autonomy.

2.8.9 Assessing in fractions

Yiannis (1997) defines "assessment" as information that has been gathered from making judgments on learners, in order to make decisions that can improve teaching and learning. The definition does not, however, give direction as to who gathers this information – although this task normally falls to the teachers. Huba and Freed (2000) argue that "assessment" is the process of collecting and discussing information from numerous and diverse sources in order to develop a profound understanding of what learners distinguish, comprehend and can do with their knowledge as a result of their scholastic practises. According to the DBE (2011) "assessment" is a continuous, planned process of identifying, gathering and interpreting information regarding the performance of learners, using various methods. Teachers' experiences will assist teachers to understand assessment in their teaching practices.

The assessment that is used to assist the teaching and learning process is called formative assessment (DBE, 2011). Bennett (2011) concurs with the DBE (2011) that formative assessment is also called assessment for learning and hence it is used during, or at the end of, each lesson. In addition, Black and William (2009) state that "assessment for learning" is a pedagogical context designed to promote learning and student's engagement in their learning. On the other hand, McPhail and Halbert (2010) argue that "assessment for learning" recognises that assessment should be part of the teaching and learning process, with information being gained from on-going assessments that inform and shape the process. This implies that "assessment" informs the learning process on a daily and weekly basis, as opposed to at the end of a unit of work.

In conclusion, Aboulsoud (2011) argues that "formative assessment" not only measures learners' achievements, but is also a powerful tool that enables learners to recognise the areas in which they are having difficulties. This suggests that a formative assessment enables students to focus their efforts on these weak areas. Aboulsoud further stated that "formative assessment" aids teachers by allowing them to monitor the effects of their teaching on learners' understanding and behaviour, so that they can modify their pedagogical strategies when needed. Hunter (2010) concurs, saying that diagnostic and formative assessments must

be part of teaching and learning. This suggests that, before beginning a learning activity, teachers should be provided with information on their students' prior knowledge and misconceptions.

In addition to the above, Bennett (2011) states that "assessment as learning" refers to co-operative and individual reflections on the evidence of learning. Bennett says that this is a process in which learners and teachers set learning goals, share learning intentions and success criteria, and evaluate their learning, through dialogue and self- and peer-assessment. Morris, Hiebert and Spitzer (2009) argue that unpacking the learning goal is a form of specialised mathematical knowledge or teaching, and is an important starting-point for studying and improving one's teaching. However, Tomlison (2010) suggests that the utilisation of assessment as learning is the final stage of a developmental phase for improving assessment practice.

"Summative assessment" is assessment of learning as it is focuses mainly on the products of learning (DBE, 2011; Bennett, 2011). Khoza (2013) concurs in asserting that "summative assessment" is a summary of the formative assessment of students' attainment of the learning outcomes for grading purposes. According to the case study carried out by Cele (2009), "summative assessment" takes place at the end of a lesson, course, semester or year. It concentrates on marking and recording scores, and also promotes the grading of learners because it is coupled with scores. This suggests that teachers are using summative assessment to grade their learners in fractions.

Kennedy et al. (2006) assert that the collection of different sets of assessments that are used to grade learners without any formative assessment element that helps learners with feedback, is called continuous assessment (CASS). This suggests that CASS is the combination of both formative and summative assessments. Hoadley and Jansen (2013) argue that CASS is the assessment that takes place at breaks throughout the period of learning. This suggests that it is made up of all the formally-recorded tasks that form CASS marks for mathematics. According to the DBE (2011), formal assessment of mathematics CAPS in the intermediate phase comprises school-based assessment (SBA) (75%) and the end-of-year examination (25%). This suggests that teachers must assess their learners using assessment for learning, assessment of learning and CASS. The CAPS document is relevant because it promotes formative assessment to foster learning. The document is in line with goals and objectives,

which imply that it is consistent. The CAPS document may be sustainable because it promotes both assessment for learning and assessment of learning.

The sixth finding of the literature that has been reviewed deals with teachers who often find it difficult to cope with increased administrative work simultaneously with developments in their curriculi (Lam & Lidstone, 2001; Hartnett, 2007). Mathematics does not only entail helping learners to develop integrated knowledge, skills and values; it also requires teachers to be efficient record-keepers and work-schedule organisers within an integrated context. This can be time-consuming and demotivating. It is also significant to note that teachers who teach fractions have to maintain records, which can cause frustration and resistance, and also demotivate teachers.

As the curriculum is a political document (Jansen, 2002), the government often exerts a level of control over it by highlighting what should or should not be studied. In higher education, where curriculum development is at the micro level, the curriculum developer and government, or the government through the institution, often clash on which ideologies should take pre-eminence, as, more often than not, this is not clear at first sight. McCormack and Gleeson (2012) argue that curriculum development or content selection will always be an "ideological battleground", and Schiro (2013) concurs that ideological conflicts in curriculum construction or development are unavoidable. Therefore, it follows that no matter whether an individual or a group of individuals is developing the curriculum, conflicts of ideology are bound to emerge.

2.9 Conclusion

In this chapter I have provided a review of literature that highlights key issues of teaching fractions in Mathematics in Grade 6, including policy developments, theoretical issues, and insights from empirical studies in South Africa.

In the next chapter I present the research methodology of my study and the design choices I made.

CHAPTER THREE
RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter discusses the procedures that were employed to explore teachers' experiences of teaching fractions in Grade 6 (CAPS). This chapter outlines the research paradigm that influenced this research inquiry, and briefly describes the study's research design. The chapter further explains the research methodology, sampling procedures and data-generation methods, explaining that reflection activity, semi-structured interviews, and focus group discussions were employed. It also describes the data analysis, trustworthiness (credibility, transferability, dependability and conformability), ethical issues and limitations of the study, and provides a conclusion.

3.2 Research paradigm

Neuman (2006) states that "a paradigm is a general organising framework for theory and research that includes basic assumptions, key issues, models of quality research and methods for seeking answers". On the other hand, Denzin and Lincoln (2008) describe the research paradigm as "the net that contains the researchers' epistemological, ontological and methodological locations in a research". The definitions mentioned above suggest that the paradigm(s) upon which a research design is based are fully understood and made clear in the research itself (Neuman, 2006).

According to Jonker and Pennink (2010) a research paradigm is a set of fundamentals and principles as to how the world is observed, and it serves as a thinking framework that guides the behaviour of the researcher. Similarly, Christiansen, Bertram and Land (2010) state that a research paradigm represents a particular world view that defines, for the researcher who carries that view, what is acceptable to research and how to carry out research. The paradigm therefore defines and guides the content and end result of research. The research paradigm and design of this study fall within the interpretive paradigm, which assumes that people are in pursuit of understanding the world in which they live and work by developing personal meaning of their experiences (Cohen et al., 2011). In short, this supports the view that all human action is meaningful and has to be interpreted and understood in the context of social practice. Thus, this research project is based on the belief that knowledge can be gained through a deeper understanding of teachers' experiences of teaching fractions in Grade 6.

Cohen et al. (2011) assert that the interpretive paradigm strives to understand and interpret the world in terms of its actors. This suggests that the interpretive paradigm is concerned with describing and explaining the teachers' experiences of teaching fractions in Grade 6. Consequently, that is why the questions of this study ask *what*, *how* and *why* in order to describe and explain the experiences of teachers teaching fractions in Grade 6. This study focuses on understanding teachers' experiences of teaching fractions to Grade 6 learners. The main aim of the interpretivist paradigm is to understand human experiences (Cohen et al., 2011). Then, the main focus of this study is not to solve the teachers' experiences of teaching fractions to Grade 6 learners but rather to understand these experiences. The experiences of Grade 6 teachers will therefore be explored to see how they teach fractions. Furthermore, the Grade 6 teachers and the schools at which they teach will provide the context.

The study aims to understand a particular social reality – teachers' experiences of teaching fractions in Grade 6 – in a school setting, so it falls under the interpretivist paradigm. The interpretivists do not aim to predict what people will do, but rather to describe how people make sense of their worlds (Christiansen et al., 2010). I conducted semi-structured interviews so that teachers would speak freely about their experiences of teaching fractions to Grade 6 learners. Moreover, in this case the interpretive paradigm enabled me to find the teachers' experiences from their perspectives (MacMillan & Schumacher, 2010). Tuli (2011) concurs in that researchers within the interpretivist paradigm are naturalistic because they relate to real-world situations as these unfold naturally. In addition, the interpretivist paradigm favours interacting and having dialogue with the studied participants (Wahyuni, 2012).

3.3 Research design

Creswell (2009) defines a research design as plans and procedures for the research that span the decision from broad assumptions to detailed methods of data generation and analysis. This research focused on teachers' experiences of teaching fractions in Grade 6. Mouton (2011, p. 55) asserts that a research design is "a plan or blue print of how you intend doing the research". According to these explanations, a research design focuses on the end product, expresses a research problem as a point of departure, and focuses on the logic of the research. On the other hand, Bertram and Christiansen (2014) state that a research design is a plot of how the researcher will generate and analyse the data that is desired to answer the research questions; and Maree (2007) argues that the choice of research design is based on the

researcher's assumptions, research skills and research practices, and influences the way in which he or she generates data. Thus, choosing an appropriate design when doing research is crucial before researchers apply the relevant methodology and data-generation methods, and utilise academic writing to accomplish their goals.

3.4 Research methodology

Qualitative research methodology was used in this study. "Qualitative methodology" is an investigation methodology that is useful for exploring and understanding a central phenomenon (Cohen, Manion & Morrison, 2007). The phenomenon is an idea that the researcher would like to explore, discover, explain, identify or describe (Cohen et al., 2007). Thus, I employed the qualitative method to explore teachers' experiences of teaching fractions to Grade 6 learners. MacMillan and Schumacher (2010) assert that the qualitative research methodology is based on a naturalistic phenomenological philosophy that views reality as a multi-layered, interactive and social experience. On the other hand, Ulin, Robinson and Tolley (2012) state that the qualitative research methodology often relies on personal contact between the researcher and the group being studied, over some period of time.

Furthermore, MacMillan and Schumacher (2010) argue that qualitative research involves the study of social phenomena from the participants' perspective and includes the participants' feelings, beliefs, ideas, thoughts and actions. Therefore, a qualitative approach enables the researcher to understand the events, situations, experiences and actions of the participants involved in the study (Maxwell, 2013). This suggests that a qualitative approach allows the researcher to understand the particular context and processes within which a participant acts. Therefore, the experiences of teachers teaching fractions to Grade 6 learners form the focal point of this study.

In addition to the above, Henning (2004) asserts that, in qualitative research, the characteristics, qualities or properties of a particular phenomenon are examined in order to achieve an enhanced understanding and facilitate a better explanation of the phenomenon. In order to accomplish this, Merriam (1998) states that qualitative research is based on the view that individuals interact with their social world to construct a reality. In this view, the researcher becomes the primary instrument for data generation and analysis by physically approaching the participants. Thus, qualitative research recognises a collaborative

relationship between the researcher and the participants, as well as between the participants and their own experiences (Maree, 2013).

Moreover, Gay, Mills and Airasian (2009) state that, in qualitative research, the researcher seeks answers to questions such as *what*, *why* and *how*. This suggests that open-ended questions should be asked, so that the participants can respond freely in their own words. Furthermore, Henning (2004) asserts that, in qualitative research, the aim is not only to scrutinise people's actions but also to find out how they represent their feelings and thoughts in these actions. Babbie (2004) states that the aim of qualitative research is to promote better self-understanding and to increase insight into the human condition. This suggests that the approach offers the possibility of a collaborative partnership between the researcher and the subjects, and also seeks to "engage the subjects in reflective practice" by asking questions that will not only provide the researcher with answers but will also stimulate the subjects to reflect on why they engage in a particular activity (Moran & Hakuta, 1995).

In addition, Creswell (2012) states that qualitative researchers deal with socially constructed realities and qualities that are complex and indivisible into discrete variables. Their duty, therefore, is to attempt to describe, understand and interpret how various participants in a social setting construct the world around them (Merriam, 2002). Denzin and Lincoln (2011, p. 3) assert that a qualitative research involves an interpretive, naturalistic approach to viewing the world, and propose that things should be studied in their natural settings in order to make sense of, or interpret, the phenomena in terms of the meanings that people bring to them.

Therefore, this study employs a qualitative design because of its inductive strategy, which is not based on predetermined or defined ideas but rather on perspectives that will emerge from the data itself. Qualitative research aims to develop perspectives and understanding. For the purpose of this study, the aim is to explore teachers' experiences of teaching fractions to Grade 6 learners. Furthermore, qualitative studies permit the researcher an opportunity to try to understand and describe the ways in which individuals make subjective sense of their lives.

3.5 Research approach

According to Christiansen et al. (2010) ethnographic, naturalistic and case studies can be used in an interpretivist paradigm. Qualitative case study is important for this study because it is descriptive, holistic, explorative and contextual in its design and aims to produce a rich description of investigated phenomena (Creswell, 2005). The case study within a qualitative approach is deemed suitable because I intend to obtain data on the teachers' experiences of teaching fractions to Grade 6 learners.

Rule and John (2011) define a case study as an orderly and in-depth exploration of a specific phenomenon or issue, in its context, with the aim of generating knowledge. Similarly, Neuman (2011) defines a case study as in-depth study of one particular case in which the case may be a person, a group of people, an organisation or a community. Crowe, Creswell, Robertson, Huby, Avery and Sheikh (2011) state that a case study is a research approach that is used to generate an in-depth understanding of an issue in its real-life situation. For the purpose of this study, knowledge will be gained from exploring teachers' experiences of teaching fractions to Grade 6 learners.

I aimed to capture the lived experiences, thoughts, perceptions and meaning-making processes (Cohen et al., 2011) of teachers' experiences of teaching fractions Grade 6 learners. This case study is a way of generating knowledge from the personal viewpoints of the participants for the issues under study. Neuman (2011) further asserts that most case studies utilise a variety of data-generation methods, including photos, interviews, observations, maps, documents and records. In this study, a case study approach allowed me to experience first-hand information through participation in the research in the form of reflective activity, semi-structured interviews and focus group interviews.

However, Yin (2009) argues that case studies can be used to clarify, describe or explore events or phenomena in the everyday contexts in which they occur, by using different sources. This creates the idea that a case study is known for dealing with research questions that involve *why*, *how* and *what* (Yin, 2009). This is because such questions deal with working links needed to be traced over time, rather than simple frequency or incidence. In addition, the participants respond freely in their own words because the questions are open-ended. Thus, using a case study helped me to explore and understand teachers' experiences of teaching fractions to Grade 6 learners. To collect the teachers' experiences of teaching

fractions to Grade 6 learners, I used the reflective activity, semi-structured interviews and focus group interviews. This confirms that teachers' experiences were explored using a variety of lenses to understand the multiple facets of the phenomenon (Baxter & Jack, 2008).

Thaanyane (2010) argues that the benefit of using the case study is that it affords an in-depth focus because the researcher spends more time with the participants. Calabrese, Colonna, Lovisolo, Parata and Ratti (2011) concur, saying that a case study is a research method that involves investigating singular or small social entities to generate data using multiple sources. The use of three data-generation methods in this study offered me more time to interact with the participants. Furthermore, a case study has an advantage of including interviews with participants (Cohen et al., 2011). Yin (2009) agrees that a case study has the advantage of including direct interviews with the participants. This suggests that a case study involves looking at a phenomenon in its real-life context. In addition, a case study allowed me to experience first-hand information through participation in the research.

I conducted interviews with all four participants. Therefore, a case study allowed me to get a full understanding of why Grade 6 teachers have experiences in teaching fractions. Cohen et al. (2011) state that a case study is not easily open to cross-checking and hence it may be subjective; and Flyvbjerg (2006) argues that a case study has a deficiency in that it allows more room for the researcher's subjective judgement. To guard against that in this study, I adopted an open stand by drawing on the perspectives of all the interviewees.

I was aware of the difficulty in making generalisations from the findings of a case study (Cohen et al., 2011). In this study, the selection of one school in which to observe the experiences of Grade 6 Mathematics teachers teaching fractions was not representative of all schools in the Ndwedwe District. The sample of the study is not necessarily a characteristic of the population (MacMillan & Schumacher, 2010). Denzin and Lincoln (2005) concur in saying that the case study would allow an in-depth understanding of the case without generalising the findings to the greater population. This suggests that the case study is dependent on one single case and is therefore not able to provide general conclusions about the phenomenon. In order to gain a more in-depth understanding, I employed sampling.

3.6 Sampling

Sampling is the process of drawing or a selecting a few individual subjects (participants) from a population (Cohen et al., 2011). The participants in this study were four Grade 6 teachers who teach mathematics in a rural school. Creswell (2010) defines sampling as the process used to select a portion of population for a study. Therefore, "sampling" implies selecting a section of a population to investigate for the purposes of a study. The sample is decided by the researcher after considering data-generation methods, the population size, and the style of the study (Chenail, 2011). This suggests that the size of the sample may change depending on the research style and population. In selecting the participants for this study I used purposive sampling.

3.6.1 Purposive sampling

Purposive sampling is a process in which a researcher hand-picks the participants to be included in the sample, on the basis of established characteristics (Cohen et al., 2011). I considered certain specific characteristics when selecting this sample, including Grade 6 Mathematics teachers, the professional role of these teachers, and their expertise in the teaching of mathematics. Charmaz (2006) states that "purposive sampling" describes a situation in which participants are selected or chosen because of defining characteristics that make them a relevant source of information. I chose Grade 6 teachers because of their experiences (Kvale & Brinkman, 2009). The sample of the study is not necessarily a characteristic of the population (MacMillan & Schumacher, 2010). Teachers are directly responsible for teaching mathematics but also have different qualifications and years of teaching at this level, this providing a possibility of gathering rich data.

Thus, the sample of this study was formed as indicated in Table 3.1.

Table 3.1 ***Profile of teachers who participated in the study***

Teachers	**Years of experience**	**Qualifications**	**Gender**
Mr. Beans	10	Diploma and Degree	Male
Mr Francis	6	Diploma	Male
Miss Peace	8	Diploma, Degree and Honours	Female
Miss Nadia	5	Degree	Female

The "experience" alluded to in Table 3.1 is the number of years that the participants have taught Mathematics. Mr Francis is most experienced, with 10 years of teaching experience and also experience of teaching concurrent to changes being made to the mathematics curriculum, including teaching fractions as defined by CAPS. This experience is important to this study because it will provide rich data. Mr Francis has six years of experience but is less qualified than Mathematics teacher A. This will allow for different perspectives as their experiences are explored in this study. Mr Francis has not studied mathematics as a major subject because there is no specialisation in the Primary Teachers' Diploma. Miss Peace has more experience, is more highly qualified than Mr Francis and has studied Mathematics as a major subject. This will allow for different perspective of their experiences. Miss Nadia has some experience and has majored in mathematics. The teachers' varying education levels also allowed an in-depth understanding of their experiences and how this influenced their teaching of fractions.

Cohen et al. (2011) state that the weakness of purposive sampling is that the researcher cannot select participants that do not have specific knowledge of the phenomenon to take part in the study. To address this weakness in the study I selected teachers who were knowledgeable about the teaching of Mathematics, and particularly fractions. However, purposive sampling is often done through convenience sampling in this study, where I chose teachers who were within reach and could be assessed conveniently.

3.6.2 Convenience sampling

According to Cohen et al. (2011), convenience sampling or opportunity sampling involves choosing the nearest individuals to serve as participants. But Creswell and Clark (2011) contend that convenience sampling involves identifying and selecting individuals or groups of individuals that are especially knowledgeable about or have experience with a phenomenon of interest. Furthermore, Leedy and Ormrod (2010) emphasise that sampling is convenient because it is dependent only on the accessibility and availability of participants. This evidently states that sampling will be based on budget and time constraints.

According to Farrokhi and Mahmoudi-Hamidabad (2012) convenience sampling is a kind of non-probability or non-random sampling in which participants are selected for the purpose of study if they meet certain criteria. I sampled Grade 6 Mathematics teachers because of their accessibility, their specialisation in Mathematics, and their willingness to participate.

Convenience sampling, however, does not come without its challenges (Zabel, 2014). The obvious disadvantage of convenience sampling is that it is difficult to generalise to other subjects (MacMillan & Schumacher, 2010). To address this weakness in the study, I ensured that the characteristics of the subjects matched those of the participants.

3.7 Data-generation methods

To generate data in this study I used reflective activity, semi-structured interviews and focus group interviews to explore teachers' experiences of teaching fractions to Grade 6 learners. Firstly, the participants (teachers) were asked to reflect on their experiences of teaching fractions in Grade 6. The reflective activity was followed by semi-structured interviews, which allow flexibility and afford interviewees the freedom to relax enough to provide rich information as the researcher probes for more responses (Cohen et al., 2011). Finally, focus group interviews were done in order to triangulate data. Triangulation is a method used by qualitative researchers to check and establish validity in their research (Mettetal, 2012).

3.7.1 Reflection activity

Valli (2009) defines "reflection activity" as an activity that looks back at the educational goals, purposes, subject matter, curriculum, school organisation and structure to ensure that they are logical. Before their interviews all of the participants were asked to reflect on their experiences of teaching fractions to Grade 6 learners. Cohen et al. (2011) and Millan (2008) state that a reflective activity is a written activity that asks participants to complete a small series of questions about the issue being studied. Therefore, this activity allowed these teachers to reflect on their experiences of teaching fractions to Grade 6 learners. Flores and Day (2006) assert that reflection is a revisiting of past experiences to inform the meaning of present or future experiences. Boud, Keogh and Walker (1985) agree that reflection is an important human activity in which people recapture experiences and assess them. According to these definitions, reflection is the process of learning from experiences so that the findings can be applied in new contexts.

To the contrary, Clarke (2003) states that reflection is a process of internal dialogue that is facilitating by thinking or writing and, through an external dialogue, is compared with others. Reflection is defined by Dewey (1960, p.9) as an "active, persistent and careful consideration of any belief or supposed form of knowledge in light of the grounds that support it and the further conclusions to which it tends". This suggests that teachers should be provided with a

range of reflective experiences when teaching. Furthermore, Spalding, Wilson and Mewborn (2002) assert that doing reflective exercises prepares teachers to identify and analyse the many complex issues that arise in classrooms.

Schön (1987) divided reflection into two main processes: reflection-on-action (looking at the past to shape the future); and reflection-in-action (occurring in the course of teaching). Hatton and Smith (1995) divided reflection into three processes: technical reflection (the process of beginning to examine one's use of essential skills or generic competencies as often applied in controlled small-scale settings); reflection on action (which itself includes three forms: descriptive, dialogic and critical reflection); and reflection in action (dealing with on-the-spot professional problems as they arise). This theory suggests that teachers should be involved in all such kind of reflections in their teaching practice.

The reflection activity in this study allowed the teachers to describe their experiences in their own time, for a period of two weeks, without my presence, thus allowing them to feel "free" while reflecting on their teaching of fractions. I then collected the outcomes of the reflective activity from the participants before we started with the semi-structured interviews, so that I had time to scrutinise them.

3.7.2 Semi-structured interviews

According to Merriam (1998), a semi-structured interview permits a researcher to respond to a situation as it unfolds. However, according to Churton (2000) semi-structured interviews also tend to provide valid data, thus creating opportunities for reflection, probing and clarifying ambiguity. In addition, Cohen et al. (2011) argue that semi-structured interviews allow flexibility, giving the person being interviewed the freedom to relax and give more information as the researcher probes for more responses. The researcher allows participants to respond in the language in which they are most comfortable.

Semi-structured interviews are useful for producing rich descriptive data that help to understand how participants construct knowledge and their reality (Nieuwenhuis, 2007). Nieuwenhuis further states that the semi-structured interview is commonly used in research projects to validate data emerging from other sources. In this study, semi-structured interviews were a follow-up to the reflection activity, and I probed the participants following the outcomes of the reflection activity. The data received from the reflective activity were

complemented by the data received from the semi-structured interviews. This data collection technique allowed me to obtain information from individual teachers away from the influence of other teachers, as each was interviewed alone (Bertrand & Hughes, 2005). This suggests that the participants should have been open, comfortable and able to express their experiences freely. Therefore I met with the participants in a quiet place and took notes during the interviews. This note-taking helped me to probe for more information. I conducted semi-structured interviews with all four Grade 6 teachers.

The advantage of using semi-structured interviews in this study was that the process encouraged the participants to speak freely about their experiences of teaching fractions to Grade 6 learners. When conducting the interviews with the teachers I tried to prevent bias. Interviewing the teachers helped me to generate the required data. All the participants answered the same questions but these questions were open-ended to allow for probing. The advantage of these interviews is that they were open-ended, therefore allowing me to follow up leads and thus generate more data. During probing I received more details from the participants on their experiences of teaching fractions to Grade 6 learners.

One of the weaknesses of the semi-structured interview process is that it is time-consuming (Pool, Montgomery, Morar, Mweemba, Ssali & Gafos et al., 2010). To address this weakness, in addition to taking notes, I recorded the 30-minute-long interviews to transcribe them at a later date. The interviews were conducted during breaks and after school hours, so that the academic programme of the school was not disturbed. The semi-structured interview process took a week to conclude and I then organised a focus group discussion to generate even more detailed data.

3.7.3 Focus group interview

According to Salkind (2012) a focus group interview is an interview of a group of participants by a researcher. Thus, a focus group interview could be described as a purposeful discussion of a specific topic or related topics, taking place between people with similar backgrounds and/or common interests. These interactions bring various viewpoints together. I used a focus group discussion with the Grade 6 Mathematics teachers to get a collective view of their experiences of teaching fractions. Niewenhuis (2007) argues that a focus group is a two-way conversation in which interviewers ask the participants questions in order to generate data and the participants also ask questions in order to increase their understanding

of the questions. During this interview, some participants were uncertain of how they should respond as they had not before been exposed to this approach (Cohen et al., 2007).

Cohen et al. (2011) believe that, in a focus group interview, the participants should interact with each other rather than being dominated by the views of the interviewer. A lot of data can be obtained when the interviewees stimulate each other to interact with the group (Flick, 2006). In sharing and comparing their experiences and views, participants generate new insights and understandings. The four participants of this study were involved in a group discussion and were able to discuss their experiences of and share their views on teaching fractions to Grade 6 learners. The advantage of a focus group is that it offers a researcher an opportunity to gather information from a situation in which participants are interacting with one another. However, the weakness of a focus group is that it is time-consuming. To overcome this weakness the focus group in this study lasted for approximately an hour and all the participants had an opportunity to express their views.

A group view was established on the same questions that were used in the semi-structured interviews, thus helping to strengthen the responses received from the other two data-generation methods (reflective activity and the semi-structured interviews). The focus group discussion was recorded and later transcribed. Table 3.2 shows the generation methods used in this study.

Table 3.2 ***Data-generation methods and sources***

Data-generation method	**Source**
1. Reflective activity	Reflection sheet
2. Semi-structured interview	Transcription
3. Focus group interview	Transcription

Table 3.2 demonstrates the data-generation methods and resources that were used to generate/produce data in this study: reflective activity, semi-structured interviews and a focus group interview. Firstly, the participants reflected on their experiences of teaching fractions to Grade 6 learners. This process was followed by semi-structured interviews with the teachers and, finally, a focus group interview was done in order to triangulate the data. I utilised multiple sources of data because I wished to pursue some form of methodological triangulation to corroborate and substantiate the findings (Merriam, 1998). Table 3.3 shows

how data were generated. I will demonstrate a strategy for my data generation by following the guidelines of Vithal and Jansen (1997).

Table 3.3 ***Data-generation plan***

	Objective 1	**Objective 2**
Why are the data being generated?	Identify and understand teachers' experiences of teaching fractions to Grade 6 learners (CAPS): A study in one rural school.	Understand why teachers have particular experiences of teaching fractions to Grade 6 learners CAPS: A study in one rural school.
What is the research strategy?	I will use a reflection activity, semi-structured interviews and a focus group interview to generate data.	I will use a reflection activity, semi-structured interviews and a focus group interview to generate data.
Who (or what) will be sources of data?	Four Grade 6 Mathematics teachers.	Four Grade 6 Mathematics teachers.
How many of the data sources will be accessed?	Four Grade 6 Mathematics teachers by means of a reflective activity, semi-structured interviews and a focus group interview will be used to generate data.	Four Grade 6 Mathematics teachers by means of a reflective activity, semi-structured interviews and a focus group interview will be used to generate data.
Where are data to be generated?	Four Grade 6 Mathematics teachers at a rural school in Ndwedwe Circuit.	Four Grade 6 Mathematics teachers at a rural school in Ndwedwe Circuit.
How often will the data be generated?	One per participant in semi-structured interviews for about 30 minutes, one per participant focus group interviews for about 30 minutes and one reflection activity per participant.	One per participant in semi-structured interviews for about 30 minutes, one per participant focus group interviews for about 30 minutes and one reflection activity per participant.
How will the data be generated?	The data will be generated through reflection activities, semi-structured interviews and a focus group interview, all of which will be recorded for easy transcription.	The data will be generated through reflection activities, semi-structured interviews and a focus group interview, all of which will be recorded for easy transcription.
Justification of this plan for data generation	The reflection activities will allow the teachers to reflect on their teaching experiences of teaching fractions. The semi-structured interviews with discussions will enable	The reflection activities will allow the teachers to reflect on their teaching experiences of teaching fractions. The semi- structured interviews with discussions enable the

	the researcher to gain a thorough analysis of participants' experiences of teaching fractions. The researcher will design an interview schedule where deductive and inductive questions will be used. These methods will be used to help the researcher to get first-hand information.	researcher to gain a thorough analysis of participants' experiences of teaching fractions. The researcher will design an interview schedule where deductive and inductive questions will be used. These methods will be used to help the researcher to get first-hand information.

3.8 Data analysis

Cohen et al. (2011) and Maree (2010) describe data analysis as a close or systematic study, or the separation of a whole into its parts. Cohen et al. (2011) further argue that, in qualitative data analysis, the researcher must make sense of the data in terms of the participants' definitions of the situation, by noting patterns, themes, categories and irregularities. In addition, Maree (2007) explains that qualitative data analysis attempts to establish how participants make meaning of a specific phenomenon by analysing their perceptions, attitudes, understanding, knowledge, values, feelings and experiences. In this study I extracted some form of explanation, understanding or interpretation from the qualitative data that were generated by the participants, by using the reflection activity, semi-structured interviews and the focus group interview.

This study utilised a guided analysis approach that included both inductive and deductive reasoning. In deductive reasoning, we start with the raw data that we have generated from the participants to identify patterns in order to draw conclusions (Christiansen et al., 2010). In this study I started by identifying patterns from the reflective activity, the semi-structured interviews and the focus group interview to draw some conclusions. Themes that were similar in the data were grouped together. Qualitative guided analysis is guided and framed by pre-existing data and concepts (Gibbs, 2007). Concepts were adopted from the curricular spider-web, which is the conceptual framework of this study. According to Samuel (2009), guided analysis is flexible in terms of allowing researchers to amend principles of theories in order to accommodate important issues that transpire from the data. Therefore, this study used guided analysis because units of analysis were developed from both the curricular spider-web and the research questions. I utilised open coding, which is well-defined by Cohen et al. (2011) as the simple new label that a researcher connects to a piece of text to describe and categorise

that piece of text. Therefore, I was able to make sense of the in-depth information that I generated from the study.

3.9 Trustworthiness

MacMillan and Schumacher (2006) state that the trustworthiness of qualitative research refers to "the degree of congruence between the explanations of the phenomena and the realities of the world". On the other hand, Merriam (2009) asserts that a research study is trustworthy to the extent that there has been some rigour in carrying it out. Furthermore, Maree (2009) states that trustworthiness refer to the manner in which the researcher can convince the readers that the findings in the study are of high quality and can thus be trusted. Therefore, the aim of trustworthiness in a qualitative research is to support the argument that the question's findings are worth paying attention to (Lincoln & Guba, 2000).

Cohen et al. (2011) assert that trustworthiness in qualitative research can be confirmed by intensive long-term involvement, rich data, respondent validation, intervention, triangulation, and other methods. Moreover, Rolfe (2006) asserts that a study is trustworthy if and only if the reader of the research report judges it to be. Trustworthiness was obtained in this study by using more than one method to see if the same data was echoed in all methods (Shenton, 2004). The fact that this study used reflection activity, semi-structured interviews and a focus group interview to generate data, ensured the element of credibility and trustworthiness.

Cohen et al. (2011) state that triangulation means generating data from a number of different sources. Mettetal (2012) asserts that triangulation is a method used by qualitative researchers to check and establish validity in their research. I used triangulation in this study to check the validity of the study. I also used a reflective activity, semi-structured interviews and a focus group interview to deepen my understanding of the teachers' experiences of teaching fractions to Grade 6 learners, in order to combine multiple views or perspectives (Barusch, Gringeri & George, 2011). Moreover, according to Yin (2009) and Creswell (2010), for the issues of trustworthiness in qualitative approaches the concepts of credibility, transferability, dependability and conformability should be used to ensure the quality of the study. The methods used to enhance trustworthiness of this study are discussed below.

3.9.1 Credibility (truth value)

Credibility is a term used to confirm what the participants say and the representation of these viewpoints by the researcher (Liamputtong, 2013). According to Silverman (2011), credibility in qualitative research "concerns the truthfulness of the inquiry's findings". The credibility of this study was supported by the choice of participants. Four Grade 6 Mathematics teachers were chosen as the participants. The case study methodology further contributes to the credibility as it characterises the reality of the participants and confirms that the obligations of the research questions are met. However, Koro-Ljungberg (2010) states that credibility in qualitative research means that the results of a qualitative study are believable and trustworthy from the perspective of a participant or subject in the research itself.

To ensure credibility, the researcher needs to spend enough time with the participants. The use of three data-generation methods (the reflection activity, the semi-structured interviews and the focus group interview) gave me enough engagement with the participants. Being part of the research during semi-structured interviews and the focus group interview enhanced the credibility of the data that was generated. I gave the participants their interview transcripts to read in order to check that what was transcribed was what was really said. This suggests that I enhanced the credibility of the research by being fair when undertaking the research.

3.9.2 Transferability (applicability)

According to Liamputtong (2013) transferability means the generalisability of a study, which pursues to correlate the degree to which the research findings of the study may be applied to other individuals, groups, contexts and settings. Grade 6 mathematics teachers were chosen as participants. Thus, if transferability of the study were to be tested it would have to be conducted with same teachers from the same school. Cohen et al. (2011) and Bitsch (2005) describe transferability as the applicability of the research findings to another context. To obtain transferability, I provided detailed descriptions of the methods used in the data-generation process to allow for comparisons by other researchers, so that similar studies can be conducted.

Bitsch (2005) states that, for the researcher to facilitate transferability he or she must use purposive sampling. To ensure the transferability of this study I used purposive sampling. To

ensure transferability of a study the researcher should create thick descriptions, including accounts of the context and the research methods, as well as examples of raw data so that the readers can consider their own interpretation (Dawson, 2009). For this purpose I included direct quotes from the participants in my findings. However, with a qualitative research approach transferability to the greater population is not needed as this study seeks to arrive at in-depth information for understanding rather than replication (Mertens, 2014).

3.9.3 Dependability (consistency)

According to Bitsch (2005) dependability refers to the stability of findings over time. Dependability of a study involves participants evaluating the findings, interpretations and recommendations to make sure that they are all supported by the data that was received from the informants of the study (Cohen et al., 2011). To enhance dependability of a study, the research process should be logical, traceable and clearly documented (Porritt, Gomersall & Lockwood, 2014). In this study the participants were given their interview transcripts to read in order to check that what was transcribed was what they really said.

3.9.4 Conformability (neutrality)

Conformability means that the data exactly represent the information that the participants provided, and the interpretations of those data are not invented by the researcher (Polit & Beck, 2012). To ensure conformability I did not allow personal issues to interfere with the study. The participants' experiences were recorded verbatim, without any tampering by myself. All the participants in this study had the same set of questions for the different data-generating methods. This implies that the questions for the reflection activity, the semi-structured interviews and the focus group interview were the same.

3.10 Ethical issues

Ethical issues refer to moral principles or rules of behaviour that researchers have to take into consideration before conducting research, particularly with the research involving humans (Cohen et al., 2011). Essentially, researchers follow certain ethical principles when conducting a study (Christiansen et al., 2010). According to the Rand Afrikaans University (2002) ethical principles should include the right to privacy, confidentiality and anonymity, the right to withdraw or terminate participation, the right to access information, and so forth. Therefore, it is important to protect the rights of participants from any harm that might be caused by the research.

I applied for ethical clearance through the University of KwaZulu-Natal (UKZN). Permission to conduct this study was received from the KZN DoE and also the principal of the school where the participants were interviewed.

Denzin and Lincoln (2011) suggest four guidelines to ensure that researchers are ethically considerate toward the participants in their research: informed consent (subjects must voluntarily agree to participate after being informed about the nature and results of the research): avoidance of deception (deliberate misrepresentation must be avoided); respect for privacy and confidentiality (the participants' identities and the research location must be protected); and accuracy (the data must be free from omissions and contrivance). In addition, Denzin and Lincoln (2011) assert that anonymity and confidentiality are the cornerstones of academic research. Miles, Huberman and Saldaña (2014) state that confidentiality refers to the agreement between the researcher and the participant as to what may be done with the data. They refer to anonymity as the absence of identifiers in the study.

In this study, confidentiality and anonymity were determined with each participant through a voluntary consent form that was provided at the beginning of each interview. This consent form specified that personal information concerning the research participants would be kept confidential, and their anonymity was guaranteed (Parry & Mauthner, 2004). Tracy (2013) states that informed consent refers to a participant's voluntary participation in research after understanding the potential risks and benefits of the study. Volunteerism, as defined in Cohen et al. (2011), was obtained via an informed consent form which made it clear that the participants may withdraw from the study at any stage. The participants signed an agreement to indicate their willingness to participate in this study. The identities of the participants and their responses were kept confidential. I used the following fictitious names instead of the names of the participants: Mr Beans, Mr Francis, Miss Peace and Miss Nadia.

3.11 Limitations of the study

According to Baloch (2011) limitations are potential weaknesses of a study and they incorporate all the factors that are impossible to avoid and which thereby affect the internal validity of research. Simon and Goes (2013) assert that limitations are matters that arise in a study and which are out of the researcher's control. On the other hand, Creswell (2008) defines limitations as shortcomings that the researcher identifies in a study. The limitations in this study were time and context. Interviews were conducted during breaks and after school

hours. Conducting interviews during breaks interfered with the teachers' time for lunch. The interviews that were conducted after school interfered with their time for going home. Some teachers indicated that they had family commitments and meetings after school. In terms of context, there had previously been robberies and hijackings at the school and some teachers were afraid to stay after school hours. To address these issues arrangements for a neutral venue and time for conducting the interviews were negotiated with the participants. The fact that I am a teacher at this same school was also a limitation as the participants thought that I was evaluating their teaching practices. As a result, one of the participants postponed taking part in the interviews. To address this I explained to them that the study was for the fulfilment of my degree requirements and not for the DoE.

My case study was a small study that involved just four teachers. The intense information that I received was used to identify and understand the experiences of these teachers as they taught fractions to Grade 6 learners in a rural school. The size of the sample makes it difficult to generalise from the population. But considering that this study did not aim to generalise, it was very important that I provide thick descriptions of each case to gain a deeper understanding of the meanings that my participants attached to their activities. Due to the open nature of the study, the participants may have tried to impress me by giving data that they felt would please me. Case studies are not easily open to cross-checking and that leads to subjectivity and bias (Cohen et al., 2011), and therefore the interviews in this study needed to be triangulated with other data sources. Cohen et al. (2011) assert that triangulation is the collection of data from a number of different sources. This study used a reflective activity, semi-structured interviews and a focus group interview to generate data. I used the reflection activity to overcome some of the weaknesses inherent in the interviews.

3.12 Conclusion

This chapter has discussed the research design and the methodology of this study. It also discussed the suitability of the paradigm and style used in the study. It further discussed sampling, data-generation methods, data analysis, trustworthiness (credibility, transferability, dependability and conformability), ethical issues and the limitations of the study. The next chapter will focus on analysing the data that were generated using the above-mentioned methods.

CHAPTER FOUR
DATA PRESENTATION AND DISCUSSION

4.1 Introduction

The previous chapter outlined the research design and methodology that was employed in this study. In this chapter I present, analyse and discuss the findings in relation to teachers' experiences of teaching fractions in Grade 6 in CAPS. The data were generated through a reflective activity, semi-structured interviews and a focus group discussion. I reiterate my key research questions as follows:

- What are teachers' experiences of teaching fractions in Grade 6 CAPS?
- How do teachers teach fractions in Grade 6 CAPS?
- Why do teachers have particular experiences of teaching fractions in Grade 6 CAPS?

To ensure the trustworthiness of my data and improve confidence in my research findings, this study used data triangulation (Cohen et al., 2011). My findings are presented under themes from the curricular spider-web concepts. I also used literature presented in Chapter 2 to critique the findings. In presenting the data, pseudonyms are used for all the research participants and for their school. In addition, to ensure that the participants' voices were not lost, their quotations are used verbatim in the discussion.

4.2 Presentation of findings

The research findings of teachers' experiences of teaching fractions are presented thematically to reveal the results of the data as generated through the transcripts of the reflective activities, and the semi-structured and group discussions. I have used guided analysis to interpret data by using concepts that were adopted from the curricular spider-web, which is the conceptual framework of this study. Guided analysis is flexible in terms of allowing researchers to amend principles of theories in order to accommodate important issues that transpire from the data (Samuel, 2009). The themes that emerged in this study echo the concepts of the curricular spider-web. Teachers' experiences of teaching fractions to Grade 6 learners, how these teachers teach fractions in Grade 6 and the reasons why the teachers have particular experiences of teaching these fractions are revealed mainly through these concepts. Questions are answered in the themes and are discussed in the following section.

4.2.1 Why are teachers teaching fractions?

- **Theme 1: Rationale**

The rationale is the major guiding component, while the other nine concepts are ideally linked to the rationale and are also consistent with each other. Findings from the teachers' reflections indicate that the reasons (rationale) for teaching fractions are personal. Their personal rationale showed that all the teachers were passionate about teaching fractions. During the interview sessions and the focus group discussion, the teachers expressed similar views and understanding with regard to the personal rationale for teaching fractions. The teachers felt that it would be very difficult to teach fractions if they themselves did not love to teach that curriculum. These teachers are always present at school and honour the times that they are supposed to teach. The following responses confirm the teachers' personal reasons for teaching fractions:

> Mr Beans, Mr Francis and Miss Nadia:
>
> *I have taught fractions for years and I enjoy it and fractions are used in daily basis and they apply to real-life situations.*
>
> Miss Peace:
>
> *I enjoy teaching fractions because I find it easy to teach because the content is given to us. Fractions apply to real-life situations.*

The findings from the semi-structured interviews and the focus group discussion also revealed that the teaching of fractions involves education benefits because the teachers equip learners with knowledge that is needed in real-life situations. Teachers were teaching fractions because they have passion for teaching them. This showed the personal rationale as the most influential rationale that drives teachers to teach their subject successfully (Khoza, 2015a). The personal rationale is what makes a successful teacher and guides them to do what needs to be done differently to prepare students for the 21st century (Hunter, 2010). When teachers are guided by personal rationales, they demonstrate a conceptual understanding of their subjects (Khoza, 2015b). It encourages teachers to engage in a quest to expand their mathematical knowledge in order to effectively teach fractions (Ball et al., 2005). Cobb and Jackson (2011) reiterate that MKT is important for the effective teaching and learning of Mathematics. When teachers seek mathematical knowledge it improves the quality of their instruction in fractions (Ball, Thames & Phelps, 2008). Teachers who lack specific mathematical knowledge were less effective in teaching Mathematics, particularly fractions.

The findings also indicated that teachers' experiences of teaching fractions were influenced by societal expectations. This means that they were teaching fractions because CAPS stated that they must do so. Findings from the reflective activity, the semi-structured interviews and the focus group discussion indicated that teachers were teaching fractions because the DBE employed them to do so. When teachers are directed by societal reasons, they comply. They do not make decisions on how to teach a particular subject. This suggests that if teachers are guided by a societal rationale, the chance that they will be successful in teaching fractions is slim. The following responses confirmed societal reasons for the teachers' teaching fractions in Grade 6:

> Mr Beans explained that:
>
> *I teach fractions because they will help them [the children] in future and they promote sharing. I do it because I had to and it is given in the policy.*
>
> Mr Francis concurred with Miss Nadia that:
>
> *I teach fractions because the curriculum wants me to do so and thus equip learners so that they will be able to know that fractions are about sharing.*
>
> Miss Peace stated that:
>
> *I teach fractions because it is the part of the curriculum. I want to help learners to understand that fractions apply to real-life situations. They must know that fractions will help in the future.*

The findings also revealed that teachers were teaching fractions in order to prepare learners for higher education. The teachers were also concerned with the achievement of measurable outcomes that become an end in themselves (Khoza, 2014). The findings are in line with the Ministry of Education (1992) which says that learners need to be taught Mathematics because it is relevant to everyday practices. Pienaar (2014) concurs, saying that fractions play an important role in our ever-advancing technological society and that many occupations today rely heavily on the ability to compute accurately, proficiently and insightfully with fractions. Therefore, while it is a basic requirement that Mathematics is taught in schools, findings revealed that it is the societal rationale that influenced teachers' experiences of teaching fractions. However, given the prescriptive nature of the curriculum teachers were battling to reconcile their personal with the societal rationales. Having to reconcile their personal beliefs with someone else's ideas removed the teachers' sense of ownership and hindered their ability to teach fractions effectively. Additionally, this influenced the teachers to adopt casual attitudes towards the teaching of fractions.

The findings of this study also indicate that these teachers were teaching fractions as a consequence of the content knowledge rationale. Content knowledge is knowledge of the subject and its structure (Shulman, 1986). If teachers are guided by content rationale, they consider that they must be knowledgeable about fractions in order to effectively teach fractions. This suggest that these teachers were skilled practitioners who had knowledge and used a variety of approaches to teach the content. The teachers believed that through their knowledge of fractions they could influence learners to learn fractions. All the teachers demonstrated practical examples of how their specialised knowledge of mathematics could influence learners to become knowledgeable in fractions. The following responses testified to the teachers' content reasons:

Mr Beans said:

I teach fractions because they are part of life and we use fractions on daily basis. If I don't teach learners fractions it would mean that I'm depriving them of their development in mathematics. It also means that I am not producing any specialist in mathematics and architecture.

Mr Francis asserted that:

I teach fractions because they are important in a real-life situation. If the learners are specialising in mathematics, they need to understand things like calculating percentages, interest rates and ratios. Fractions are important in that sense because they are the basic if you'll end up specialising in maths and they produce learners with skills that will contribute towards science careers.

Miss Peace explained that:

I teach fractions to let learners know that parts of the whole exist. I help them develop the thinking skill. Mathematics introduces learners to the basics of being a specialists in mathematics, accountant etc. To help them do practical works. Help them to have more vocabulary of maths.

Miss Nadia stated that:

As a qualified mathematics teacher, I teach fractions to enforce the idea that fractions are part of the whole. Secondly, the fraction is part of the whole and if you take a fraction from the whole, you are left with a fraction. Lessons taught daily make up one whole which is teaching of mathematics. As a teacher I teach mathematics to develop a basis for engineers, teachers etc. I think this is the basic of teaching fractions that every teacher may use.

The findings indicated that the teachers' professional knowledge equipped learners with a necessary knowledge of fractions. This means that when learners are engaged with fractions they will be able to apply the knowledge they have mastered to manipulate fractions without any problem. This theory is supported by Ernest (2010), who argues if learners have Mathematics knowledge then they have the potential to excel and they, ultimately, will be rewarded with well-paid jobs.

The teachers' responses also revealed that the teaching of fractions depended upon knowledgeable teachers who understood the subject matter (Ball, Bass & Hill et al., 2005). This suggests that, if teachers who are teaching Mathematics are not knowledgeable in fractions they will not be able teach fractions effectively. Data generated in this study also indicated that these teachers teach fractions to instil mathematical problem-solving skills in learners. These teachers take their teaching as a professional obligation and are driven by their knowledge to attain curricular aims, particularly the teaching of fractions. They also believed that every learner should have knowledge of mathematics in order to solve problems in their real-life situations. Hence, these teachers' professional knowledge promotes this engagement.

Generally, the findings of this study suggest that teachers were able to reflect on the rationale for teaching fractions even though they were not aware that they were guided by rationales in their teaching (Berkvens et al., 2014). Supporting this idea is Khoza (2013), who states that awareness of rationales promotes a good connection between theory and practice. Simply having rationales encourages teachers to question the curriculum ideology as they plan their teaching and consequently, construct a personal rationale for teaching. The next theme looks at the goals that these teachers have set.

4.2.2 Goals towards which teachers are teaching

- **Theme 2: Goals**

The data generated from the reflective activity indicate that these teachers did not know the difference between the aims, objectives and learning outcomes of their teaching. They responded without indicating whether they were reflecting on aims, objectives or outcomes. This suggests that the teachers did not understand the difference between these aims, objectives and learning outcomes. As a result, the teachers struggled to plan for their

teaching. It is important for teachers to understand aims because they determine the content that must be taught (Kennedy, Hyland & Ryan, 2006).

Kennedy et al. (2006) and Khoza (2013) reiterate the importance of having aims, objectives and learning outcomes, and state that teachers must identify long-term goals (aims) during short-term goals (objectives) and what the learners will know, understand and be able to demonstrate after completion of a programme of learning or individual subject/course (learning outcomes). "Aims" articulate the skills and knowledge a learner has acquired after completing a learning programme (Rauhvargers, Deane & Pauwell, 2009). If teachers do not understand amiss, they may fall short of a conceptual understanding of what they are teaching. The following responses affirmed teachers' understanding of goals.

> Mr. Beans asserted that:
> *I teach fractions so that learners will be able to name and recognise fractions. Compare and order them. Recognise equivalent fractions but most importantly solve problems using fractions.*
> Mr Francis stated that:
> *I teach fractions so that learners will recognise the context of sharing and have a clear understanding of the relationship between division and fractions.*
> Likewise, Miss Peace stated that:
> *I teach learners fractions to ensure that they solve their immediate problems to improve life and also develop their economy and that of their country.*
> Miss Nadia asserted that:
> *I teach learners fractions so that learners must understand how to work together or co-operate. Distinguish between halves, quarters, thirds and a whole.*

The teachers' explanations indicate that teachers were not aware that CAPS is driven by aims, as they did not indicate during their reflections, the semi-structured interviews and the focus group discussion whether they were reflecting on aims or objectives. CAPS (2011) has aims and they are called general aims. The objectives are presented as specific aims in CAPS. However, aims/objectives specified in Mathematics documents are general aims of the planned curriculum and the implemented curriculum. These aims/objectives are not specific to the teachers' intentions when teaching a certain topic or content. For example, there are no

specific aims stated in the CAPS document that guide the teaching of fractions in mathematics. As such, they remained unrecognised in their planning for teaching fractions.

The aims in CAPS are general and specific to subjects. It is also not clear whether the aims are appropriate for teaching fractions. Aims and objectives in education monitor decisions on the content of subjects and whether there is attainment of these aims (Berkvens et al., 2014). They assist teachers to align the content of the subject with intended learning outcomes, objectives and aims. Kennedy et al. (2006) corroborate the importance of aims and say that they regulate the content being taught. Aims and objectives in mathematics teaching outline the three perspectives: student (creating job opportunities and building self-esteem); society (knowing the value of society); and subject (how mathematics is taught) (Berkvens et al., 2014). These emphasise the importance of teachers' understanding of aims, objectives and learning outcomes in teaching and learning processes.

The teachers' accounts also indicated that they only know the action words for the formulation of aims, objectives and learning outcomes, and did not understand Bloom's taxonomy and the cognitive levels during the construction of these. They were not aware that the learning outcomes are measured by or observed from learners' performance. The lesson must have observable and measurable learning outcomes in order to achieve consistency of delivery, transparency and clear information for learners to demonstrate knowledge learnt (Adam, 2004). Learning outcomes are constructed according to specific measurable keywords that reflect on different levels of an activity for the learners so as to achieve the learning outcomes (O'Brien & Brancaleone, 2011). Furthermore, learning outcomes should be designed based on the cognitive levels of Bloom's taxonomy model for effective assessment to occur (Khoza, 2013).

Generally, the findings indicated that teachers did not know the difference between aims, objectives and learning outcomes when they were teaching. Teachers' knowledge of aims, objectives and learning outcomes is important so that they do not deny goals when teaching fractions. They remain with an obligation to recognise aims, objectives and learning outcomes in their practices in order to teach effectively. However, the way to reach the aims and objectives component is explained by the content of teaching fractions.

4.2.3 Content that they are teaching in fractions

- **Theme 3: Content**

The data generated from the semi-structured interviews and the reflective activities indicated that teachers used the mathematics CAPS document as a guide to content of what is to be taught in fractions. The content for teaching fractions is calculations, describe and order fractions, problem solving, percentages and equivalent fractions.

Mr Beans and Miss Peace said that:

I teach learners to describe and order fractions, do calculations with fractions, solving problems with fractions, percentages and equivalent fractions.

Mr Beans added that:

I teach learners to solve problems with fractions, describe and order fractions, percentages, equivalent fractions and to do calculations with fractions.

Mr Francis and Miss Nadia mentioned the same topics in fractions and added that they teach the content and link it with real life situations. Mr Beans stated that:

One example is taking an orange and dividing it in half and explain that is one over two (1/2). I would then cut it into four parts and tell them that that is one over four (1/4), each part representing a quarter of the orange. This enables them to see equivalent fractions, describe fractions and they can be able to order fractions.

Mr Francis maintained that:

I ask the learners prior knowledge of fractions and I let them count in fractions because learners are familiar with 1/2. I give them more examples of real-life situations and I also use real objects. For example, I would cut a loaf of bread into two equal parts with part representing 1/2, with one representing the numerator and two representing the denominator and this forms a background for doing calculations with fractions, ordering of fractions.

Miss Peace explained that:

It is as I said before. I also check how much the learner knows about fractions so that I don't teach something they already know and then follow the syllabus. I incorporate examples of fractions used in daily life situations. This will help learners to solve problems with fractions, compare the fractions and do ordering of fractions.

Miss Nadia explained that:

I physically bring in one loaf of bread, cut it into two equal halves, cut each half into two equal quarters. This can help learners do calculations with fractions, ordering of

fractions and comparing of fractions. This helps a lot because with this practical, the learners are able to understand what a half and quarter are as it is cut in front of them and I think this is the best skill a teacher can use in order to make a clear picture of fractions.

Findings indicate that teachers confidently mentioned the content in fractions as solving problems with fractions, describing and ordering fractions, percentages, equivalent fractions and doing calculations with fractions. This suggests that teachers were familiar with content of fractions entailed in the curriculum (Bush, Kiggundu & Moorosi, 2011). Hoadley and Jansen (2013) also agree that teachers must know all the topics of the subject they are teaching so that they will yield good results when teaching fractions.

Findings also revealed the beliefs that influenced these teachers' teaching of fractions. They believed that their background, experiences and content knowledge were essential in presenting content in the fraction classroom (Ball, Thames & Phelps, 2008). This was based on the fact that teachers enter the profession with personal values and belief systems (Lieberman & Miller, 2011). Essentially, such factors inform teachers' enactment of their practices. Teachers' schooling experiences of how they were taught fractions interfered with their practices of teaching fractions in Grade 6. As a result, they found that they were confused by the methods/approaches of teaching fractions that are prescribed by the curriculum.

In short, teachers' previous knowledge, beliefs, ideas and previous experiences in teacher education influence how they teach (Loucks-Horsely et al., 2003). This is further corroborated by Isiksal and Cakiroglu (2011), who state that teachers' challenges of teaching fractions stem from their experiences. A mismatch in practices offered an indication that teachers did not fully understand the content in fractions (Landsberg, 2005).

Additionally, the prescriptive nature of the curriculum discarded teachers' autonomy on the content to teach. This is further corroborated by Msibi and Mchunu (2013), who argue that CAPS is a content-driven curriculum with detailed explanations that are laid down for teachers to follow when teaching. Such approaches to curriculum design deny the teachers opportunities to take autonomous decision on how to teach fractions. This was found to hinder teachers with years of experience of teaching Mathematics, who had an understanding

of how to assist the learners when they were experiencing problems in fractions. They were denied innovative ways of teaching fractions. The next theme is about teaching activities that determine teaching and learning.

4.2.4 Teaching activities when teaching fractions

- **Theme 4: Teaching activities**

The data generated through the teacher reflection, semi-structured interviews and focus group discussion revealed that the teachers used different activities when teaching fractions: worksheets (shading a diagram to form given fractions and representing fractions on a number line); and cutting A4 papers. Learners compared equivalent fractions according to the assigned groups. Teachers were teaching the same content but they used different activities to teach. This showed that teachers understood the importance of activities but implemented them differently.

It was interesting to find that teachers designed learning activities using common sense and what they felt was necessary as an activity. As a result, it was not clear whether the activities that they used for teaching were effective in enhancing the teaching of fractions. This is further corroborated by Van den Akker et al. (2009), who argue that during teaching it is important to consider the best activities for attaining the subject aims. This indicates that aligning the activities with the aims will help the teachers to select relevant activities that will improve the teaching of fractions.

Mr Beans stated that:

I give learners worksheets with circles, rectangles or other geometric shapes cut into fraction pieces. Learners compared equivalent according to the allocated groups. That forms background knowledge for doing calculations of fractions.

Miss Peace mentioned the following:

I teach learners how to represent fractions in a number line. By doing that we lay the background for doing comparing and calculations in fractions.

Mr Francis asserted that:

We divide the A4 papers into pieces so that learners will recognise it as a whole, half and a quarter. That will help learners to compare, solve and calculate fractions.

Miss Nadia stated that:

To assist learners to master calculations in fractions we first use real objects like cutting A4 papers into different fractions so that they will come to recognise them.

The teachers' accounts indicated that teachers use different activities, including concrete objects, to teach fractions. They believed that using real objects promoted learners' interests of learning fractions. Teachers showed the competence in designing learning activities that were at the appropriate level of learners. These activities also took consideration of the learners' home backgrounds (Ball, 1990). This is supported by Zulu (2013), who argues that learners need to be taught using what is known from their cultural backgrounds and environments. The use of concrete objects laid foundation for doing calculations in fractions (Brijilall, 2014). The use of concrete objects helped teachers to demonstrate the fractions (Yun & Flores, 2008). Similarly, in New Zealand and Australia teachers use concrete objects when teaching fractions. Real objects have been found to facilitate the effective teaching of fractions (Pape & Tchoshanov, 2001). Therefore teachers should give learners opportunities to explore fractions through hands-on experiences.

The teachers' responses also showed that teachers used different activities (worksheets; shading a diagram to form given fractions; representing fractions on a number-line; and cutting A4 papers). Findings revealed that using the same activities for teaching fractions was impossible because learners were different in terms of grasping fractions. The activities that teachers used were learner-centred; hence teachers were facilitators of learning. Nevertheless, if the activities are subject-centred the teacher is the source of knowledge and the learners remain passive recipients of knowledge. If there is no active participation of learners in the class, learners become uninterested hence there can be no effective teaching of fractions.

Perceiving learners as empty vessels ready to be filled with knowledge makes a lesson like fractions uninteresting. In support of the latter are Harris and Hofer (2011), who suggest that teachers must use practical activities so that learners make meaningful learning. This suggests that practical activities are effective for both teachers and learners in the teaching of fractions (Long, 2004). Teaching of fractions through learner-centred activities approach yield good results (Qazi & Rawat, 2014).

Generally, the findings from the teachers' experiences revealed that teachers employed different activities, including concrete objects, when teaching fractions in their classrooms. They believed that learners understand quickly when they link real objects to numbers. This is generally based on the belief that it is advantageous for learners to be allowed to move from the concrete to the abstract. This indicates that the use of real objects further encourages

more abstract thinking when teaching fractions. The next theme looks at the role of the teacher when teaching fractions.

4.2.5 The role of the teacher when facilitating fractions

- **Theme 5: Teacher role**

These teachers understood their roles as facilitators and instructors. Teachers were facilitators (learner-centred philosophy) when they guided learners' knowledge in order to make their own meaning during the teaching process. This implies that when teachers were allowing the learners to help each other during group work they were facilitators. The learners were active participants in learning and co-constructors of knowledge. When teachers gave learners theory of fractions, they were instructors. Teachers acted as instructors when they exercised control and guided learners on activities. This denotes that the teachers had more control over the selection, sequence and pace of learning.

In addition, this teachers' roles as instructors do not consider learners' prior knowledge as important. This suggests that the teachers did not allow enough space for personal development and growth of learners. Khoza (2013) argues that if teachers use aims and objectives to drive their lessons it shows that teachers are using the teacher-centred approach. Teachers must know the approach they are using when teaching fractions to locate their roles. However, when teachers assumed roles of being facilitators, they consider learners' prior knowledge. Teachers' teaching strategies were shaped by the teachers' understanding of the learners' prior knowledge. They align their teaching approaches with learners' prior knowledge in order to avoid misconceptions before they begin a learning activity.

Mr Beans said:

I first explain what fractions are and I divide the learners into groups. I give them an apple to divide into pieces so that they associate each piece with a fraction.

Mr Francis expressed a similar opinion:

I first define the fractions to the learners. Then I draw pictures showing or representing them. I group them and give them A4 paper to cut so that peers will help each other.

Miss Peace stated that:

I explain what fractions are. I divide learners into groups. Learners help one another to name the given fractions in the worksheets.

Miss Nadia concludes that:

I first give the learners the definition of fractions. I do some examples on the chalkboard and then I group them so that the peers will assist the others.

Deducing from the findings of the reflective activity, semi-structured interviews and focus group interview, the teachers' responses revealed that all of them understood their roles as facilitators, instructors and researchers when teaching fractions. Their accounts also revealed that they had challenges in performing their roles when they teach fractions. The following responses affirmed what teachers said:

Mr Beans asserted that:

I firstly consult my curriculum policy for the content to teach. I ask the prior knowledge of fractions from learners because fractions have been introduced in previous grades. They must be able understand what the numerator and the denominator are all about. My role is thus teacher-centred and a facilitator because I am telling learners what to do and I instruct learners to take their textbooks and exercise books so that they will do the activity in groups.

Mr Francis stated that:

I firstly check the learners' pre-knowledge from previous grades by asking for fraction definition. I then pose questions to them like how would they identify a fraction. I then start my lesson by showing them what a numerator and a denominator are, with an example, meaning that I am an instructor when teaching fractions. I am a facilitator when learners are working in groups to do some activities.

Miss Peace stated that:

I first consult my policy document and then do preparations for my lesson. Firstly, I check learners' prior knowledge. Then I use teaching aids to show the learners the different types of fractions. I facilitate teaching of fractions when learners are doing activities in group.

Miss Nadia stated that:

I draw pictures showing or representing those fractions. I instruct learners to do the activity in groups while I facilitate the activity.

The teachers' roles in any educational context are very important because learners need guidance during the learning process. Deducing from the findings, it emerged that teachers were not aware of what influenced their roles when they teach fractions. Landsberg (2005) states that a teacher is a facilitator (learner-centred) who creates a classroom environment in which learners can appreciate the learning opportunities and make sense of the knowledge,

skills and values being learnt in fractions. If teachers are using learning outcomes to drive their lessons it means that teachers are using the learner-centred approach (Khoza, 2013). Learner-centred education suggests that human beings learn by actively constructing and assimilating knowledge rather than through the passive addition of discrete facts to an existing store of knowledge (Kouwenhoven, 2010; Hardman, Abd-Kadir & Smith, 2008). This denotes the role of the teacher is to be an instructor and facilitator in competence curriculum when teaching fractions (Hoadley & Jansen, 2014).

The teachers' responses also indicated that they were conscious of the importance of their roles when teaching fractions. This is corroborated by Khoza (2013), who states that teachers as instructors use content to drive their lessons. They concentrate on the content they teach and on what they do "best" in teaching, thus, advocating an instructionist's view of teaching, which is corroborated by Kember and Kwan (2002) who state that teachers as instructionists believe that learning is the direct result of having been taught. Therefore, teachers decide which role to assume when teaching fractions via the CAPS method. Generally, the findings indicate that teachers' roles were instructors and facilitators when teaching fractions (Hoadley & Jansen, 2013).

4.2.6 Why do teachers have particular experiences of teaching fractions in Grade 6?

The data also revealed why teachers have particular experiences of teaching fractions in Grade 6. Resources, grouping, time, location and assessment were highlighted as being the most influential on teachers' experiences. Following is a discussion on how these concepts shape teachers' experiences of teaching fractions.

4.2.7 Resources for teaching fractions

- **Theme 6: Resources**

The findings revealed that resources influenced teachers' experiences and impacted on their teaching. Resources such as bread, fruit, textbooks, charts, chalkboards and workbooks were found to be the common resources used for teaching fractions. This signifies that teachers were using different resources when teaching. In order for a resource to be effective, there has to be a dialogue between the teacher and the learner while using the resource as a medium of explanation (Andrews, 2007). This suggests that the resources encourage thinking and dialogue about fractions. Teachers took into consideration that the use of resources which were available enabled their pupils' learning of fractions. As such, they believed that the use

of resources helps learners to develop and analyse strategies for adding and subtracting fractions. In addition, Van den Akker et al. (2009) state that resources are mainly thought of at the micro (school) level of curriculum development where the teachers select which materials to use when they teach.

Mr. Beans explained that:

As I've already mentioned above, I use bread, apples and oranges. The learners also make use of these by cutting them. I also use textbooks, the CAPS document, and the learners themselves, by separating them by gender. I then tell them that the top number is numerator and the bottom number is a denominator. The resources are not sufficient.

Mr Francis asserted that:

I use concrete objects, textbooks, and drawing on the chalkboard. The textbook may be too structured for some learners compared to the dynamic and fun experience that they get when they do hands on mathematics. The challenge I have is that the teaching aids are not sufficient and, as a result, I have to improvise in most which is not enough in the teaching of fractions.

Miss Peace expressed that:

As I mentioned before, a loaf of bread can be helpful, an orange and an apple. I also use textbooks, the chalkboard and charts. The resources are not sufficient.

Miss Nadia said that:

The Department [of Education] provides us with departmental workbooks which are an excellent and colourful teaching aid but they are not sufficient. Bread and oranges are another way for the learners to identify fractions. The use of charts and chalkboards gives learners a clear understanding of what they are being taught in fractions.

Generally, the teachers' responses indicated that they used resources that were known to learners from their home background. However, Martinie (2005) asserts that the primary resource for mathematics, including the teaching of fractions, is the textbooks. Kelly (2009) supported the significance of textbooks and states that books determine the knowledge that the curriculum aims to convey. In addition, Remillard and Heck (2014) also assert that textbooks are the most common form of curriculum material (resource) used throughout the world. Taylor (2008) also agrees that textbooks greatly assist the teacher not only with daily lesson planning but also to achieve curriculum coverage. In this case, findings revealed that

these teachers' experiences of teaching fractions were hampered by the shortage of mathematics textbooks, as Miss Nadia asserted that:

> *I sometimes download activities to use when teaching fraction because we have a shortage of textbooks.*

The non-availability of resources such as textbooks raises serious concerns about the teaching of fractions in Grade 6. Cobb and Jackson (2011) maintain that the provision of good-quality instructional materials is crucial as it assists teachers with lesson preparation. Furthermore, resources also allow them to select, organise, sequence and pace their lessons. However, the shortage of workbooks impeded the teaching of fractions. Currently there is a shortage of textbooks in schools, particularly those that are supplied by the DBE. The DBE tends to work on the previous years' statistics regarding the number of learners in each grade; as a result some grades experience a shortage of workbooks.

Miss Nadia said that:

> *The Department [of Education] provides us with departmental workbooks which are an excellent and colourful teaching aid but they are not sufficient.*

The DBE introduced workbooks as supplementary study material for learners but the findings revealed that teachers did not use them the way they were supposed to. Remillard (2000) and Collopy (2003) opine that the way in which teachers cooperate with curriculum materials are shaped by characteristics of teachers themselves such as their knowledge, beliefs and experiences. Mdluli's (2014) findings revealed that teachers use the mathematics workbooks in ways that did not resonate with the DBE's intentions. As a result, Spaull (2013) states that teachers must be taught that the workbooks serve to structure the curriculum, in order to allow for full coverage of the curriculum. This is further corroborated by Prinsloo (2007, who posits that the lack of resources is one of the major barriers to smooth curriculum implementation in South Africa.

As such, sufficient resources to ensure the successful teaching of fractions remained a major hindrance. Generally, the teachers' accounts indicated that teachers were experiencing a shortage of resources, particularly mathematics textbooks, as the main teaching resource. The next theme looks at how teachers group their learners when they teach fractions.

4.2.8 To whom are they teaching fractions?

- **Theme 7: Grouping**

The voices of the teachers suggested that teachers faced many barriers in their endeavours to impart learning. Firstly, the resources were insufficient for teaching fractions. The availability of resources thus dictated the direction of the content to be taught and the teaching strategies to be used. The focus group revealed that management did not provide enough resources for teaching fractions. As a result, teachers grouped their learners so that they will access the resources and help each other.

Mr Beans stated that:

When I teach fractions I group so that learners will help access resources because the resources are insufficient.

Mr Francis asserted that:

The challenge that I have is that the resources are not enough, as a result I group my learners.

Miss Peace said:

The teaching aids for teaching fractions are insufficient as a result I group learners so that they help access the resources.

Miss Nadia said:

I group the learners because resources are not sufficient.

Teachers believed that grouping learners would help learners to have equal access to resources. They also believed that introverted learners get an opportunity to express themselves in groups. However, there were challenges in managing groups as a result of learners who dominated the activities. Teachers' voices also revealed that teachers believed that their workloads and class sizes were another barrier to the teaching of fractions. Teachers indicated that were facing problems due to insufficient floor space; as a result they were unable to pay attention to each group and each learner. The teachers in this study also highlighted that workload affected learners' performance in fractions as they were teaching many subjects.

Mr Beans stated that:

The challenge I encounter is that learners are overcrowded and I fail to pay individual attention to groups because of the workload.

Mr Francis asserted that:

The workload is restricting me when I want to pay attention to all learners in my class as I am also dealing with a huge number of learners in the class.

Miss Peace said:

Learners are overcrowded and the workload is restricting me to pay attention to all groups in the class.

Miss Nadia stated that:

The workload and the number of learners are challenging me when teaching fractions. The groups are out of hand.

The teachers' explanations revealed that they believed that big groups are not ideal for the teaching of fractions because this process requires one-on-one attention from teachers. Big groups created discipline problems in the class. This signified that the overcrowded classes were beyond the abilities of teachers and to manage. They also prevented the teachers from giving individual attention to struggling learners. This is corroborated by Khan and Iqbal (2012), who argue that the majority of teachers face instructional and discipline problems in overcrowded classrooms, which affects their performance in class. Teachers were challenged by the subject workloads that they were carrying. Some of them were teaching many subjects and had to change the lessons and teach another subject even if the learners had not mastered the fraction content.

Data also revealed learners' attitudes as a barrier against the teaching and learning of fractions. Teachers' characteristics and attitudes have great influence on learners' Mathematics learning, achievement and the type of attitudes developed toward Mathematics (Di Martino & Zan, 2010). Yara (2009) points out that learners' attitudes towards Mathematics are influenced by teachers' teaching methods and personalities. This showed that the learners' attitudes towards fractions posed serious problems to teachers during teaching. For example, during teaching, teachers indicated that learners did not concentrate because they believed that fractions were difficult. This led to their success or failure in learning fractions (Mata, Monteiro & Peixoto, 2012).

Mr Bones commented that:

Learners have fractions anxiety.

Mr Beans mentioned that:

Learners fear fractions and as a result they do not concentrate when learning fractions. They develop a negative attitude because of negative previous experiences.

Miss Peace who expressed the same opinion that:

Learners are not motivated when faced with fractions and that negative compounds it as the years go by. Learners' attitudes towards fractions are different.

Miss Nadia stated that:

Learners believe that fractions are difficult. The learners' facial expressions indicate that they are finding the difficulty in fractions.

The teachers' responses revealed that learners' attitudes towards fractions were the result of psychological factors, including anxiety, fear and motivation. Anxiety, particularly towards fractions, refers to a person's feeling of tension and anxiety with the manipulation of numbers (Khatoon & Mahood, 2010). Teachers believed that the sense of discomfort observed in learners when learning fractions was associated with fear (Ma, 2003). A fear towards fractions in Mathematics classes was found to hinder learners' positive thinking about learning fractions. The fear caused low self-esteem, disappointment and learning failure in learners when learning fractions (Tobias, 1998).

One of the factors attributable to anxiety about fractions was a lack of confidence that resulted to reduced levels of motivation (Hlalele, 2012). Motivation is regarded as a learning enabler and a key component in learning (Linnenbrink & Pintrich, 2002).According to the teachers, they were fighting a 'losing battle' in trying to change learners' attitudes towards fractions. Based on this belief, teachers motivated the learners to handle fractions with confidence in their classrooms. Teachers believed that fractions are a crucial part of human existence and experiencing failure in the early stages in fractions teaching can limit future development.

Teachers' attitudes towards the teaching of fractions were also found to have an effect on learners' performance. This suggests that teachers with a positive attitude towards fractions are motivated to stimulate favourable attitudes in their learners (Yara, 2009). Primary school teachers often held negative attitude towards Mathematics and this negative attitude can result in poor teaching of fractions (Australian DoE, 2007). This is an upsetting discovery, as positive attitudes towards the teaching of fractions have a direct influence on the levels of performance (Sullivan, 1987). This indicates that learners are affected by the way that teachers teach fractions in the classroom.

However, Mr Francis took a different perspective and focused on the contextual factors that affected the learners' academic performance:

We are a school that admits every learner from any school. The challenge I have is that the furniture is not sufficient and the classroom is not in a good condition.

In terms of the contextual factors, Miss Peace stated that:

> *The floor space is limited because of the number of learners we have. The difficulty comes when you don't explain fractions to them initially because the word "fraction" intimidates learners especially those who do not have English as their home language.*

Miss Nadia echoed that:

> *The class size of learners leads to the shortage of furniture and disturb the seating plan for the activity of the day. The classroom is in a bad condition.*

The findings indicated that teachers' experiences of teaching fractions were beset by different contextual factors. The school infrastructures such classrooms and desks made it impossible for the teachers to organise learners the way they wanted. The unavailability of furniture also hampered teachers' mathematical practices they wanted to use. The classrooms conditions were not conducive for effective teaching and learning of fractions. For instance, teachers cited broken windows and desks as some of the challenges that impede teaching and learning of fractions in particular.

The language of instruction was highlighted as a barrier to convey the meaning of fractions (Hurrell, 2013). Learners come to class with different competence in the language of instruction. Therefore, their pace to grasps the fractions was not the same. Mathematics is a language on its own that has concepts and therefore makes it difficult for learners who have isiZulu as their first language to understand. Learners are not taught in their mother tongue in the Mathematics classroom, the language of teaching is English (Landsberg, 2005). Therefore, teachers indicated that the language of teaching and learning is a barrier for learners' understanding of fractions. It is believed that teaching and learning in the home language increases the self-esteem and academic performance (Altinyelken, 2010). Assessments and instructions are written in English in Grade 6, thus it is not easy for learners to cope. This shows that language has become an impediment to academic achievement in mathematics in South Africa particularly in Grade 6 (Hugo, 2008). ANA conducted in intermediate phases in Mathematics demonstrated that learners could not understand the language used in assessments tasks (DBE, 2012).

Cohen (2010) argues that access to education emanates from a variety of social citizenship rights that are intended to afford members of a society an opportunity to share in a basic level of social, economic and cultural well-being and to mitigate inequalities. This is substantiated

by Berkvens et al. (2014), who argue that children should have access to education irrespective of their ethnicity, socio-economic status or gender. All schools in South Africa are offering the CAPS Mathematics curriculum, and as most public schools are no fee-schools, class sizes are big. This is further corroborated by Borkum (2012) who argues that the no-fee programme led to an increase in enrolment in South African schools.

Deducing from these findings, teachers were faced with numerous barriers presented by a lack of resources, insufficient furniture, poor conditions of classrooms and a high workload in teaching fractions. Hence, they taught in ways that responded to what deemed fit in order to teach.

4.2.9 Time and location for teaching fractions

- **Theme 8: Time and location**

The findings indicate that the teaching of fractions was occurring in the morning of every weekday, as since Mathematics is taught early during the first periods. Teachers believed that learners must be taught fractions in the mornings, so that learners will pay attention.

Mr Beans said that:

> *I teach fractions in the morning every weekday in the classroom. Because of the time given for Mathematics I end up having morning classes.*
>
> Mr Francis asserted that:
>
> *I teach them in the morning from Monday to Friday in the classroom since Mathematics is taught early during the first period.*
>
> Miss Peace echoed that:
>
> *I teach them in the morning every weekday in the classroom. The time given to teach fractions is not sufficient; I end up having morning classes.*
>
> Miss Nadia stated that:
>
> *Fractions are part of Mathematics so they are usually taught in the morning – in the first period. The curriculum is also a restriction when teaching fractions.*

The findings revealed that teachers were teaching fractions in the classroom. This is corroborated by Van den Akker et al. (2009), who said that teaching may take place anywhere inside the school building. During the focus group discussion, these teachers agreed that the parents were not interested in helping their learners with homework. They did not receive support from the parents. The teachers said that some parents fail to assist their

children with homework because they themselves were illiterate. However, teachers are left with no choice but to continue to give homework as an enhancement strategy to understand fractions. Homework is a combined effort involving learner, teacher and parent, in which all parties have a vital role to play regardless of their educational background (Harris & Goodall, 2008; Hong, Wan & Peng, 2011). These teachers' accounts also revealed that their learners were not receiving support from parents because of the school's rural context. Even so, teachers retain the responsibility for possessing knowledge of the different learning situations, contexts and environments of education, as well as prevailing policies, and the political and organisational contexts (DBE, 2011). Therefore, if teachers lack understanding of the context, the chance that they will be successful in the teaching of fractions is slim.

The findings also indicated that the time allocated for mathematics was not sufficient for the teaching of fractions. The teachers indicated that they conducted extra classes in the morning to cover the fractional content. The time for teaching fractions for terms one and two is 20 hours and, for terms three and four, is 10 hours (DBE, 2011). This is corroborated by Msibi and Mchunu (2013), who state that the CAPS document spells out exactly what teachers need to cover in each term and gives the number of weeks for each topic. This suggests that CAPS allows for far less choice on the part of teachers in terms of what to teach, when to teach it, and how long to spend on different topics. This also indicated that teachers were coerced to go to the next topic, even if the learners had not mastered the current one. The following theme is about assessment in fractions.

4.2.10 Assessing in fractions

- **Theme 9: Assessment**

The findings from the teachers' experiences indicated that teachers were guided by the CAPS document when assessing fractions. They said that they use both informal (formative) and formal (summative) assessments (Khoza, 2015b). Formative and summative assessments are important when ensuring the attainment of learning outcomes in fractions. During the reflective activity the teachers stated that they gave learners class work, weekly tests and homework as assessment strategies for fractions. They found that formative assessment was more suitable. This is substantiated by Aboulsoud (2011), who posits that formative assessment is a powerful tool that enables learners to recognise the areas in which they have difficulty.

McPhail and Halbert (2010) also agree that formative assessments should be part and parcel of the teaching and learning process. Formative assessment is called "assessment for learning" and hence it is used during, or at the end of, each lesson (DBE, 2011). This suggests that formative assessment is intended to support the improvement of learners when teaching fractions. Hunter (2010) articulates that formative assessment must be part of teaching and learning. This implies that formative assessment informs the learning process on a daily and weekly basis, as opposed to at the end of a unit of work.

Mr Beans stated that:

I give them class work to see how they are developing, and thereafter homework. I also give them weekly tests and I do not record this.

Mr Francis who asserted that:

I assess learners informally by giving them class work and homework but these assessment are not recorded.

Miss Peace stated that:

I give them class work. I will start by giving them two sums to check if they understand and then homework, which is more than the class work.

Miss Nadia stated that:

I give learners class tests, class work and homework and I do not record marks for promotion purposes.

During the semi-structured interviews and the focus group discussion, the teachers' voices revealed that they gave their learners formal assessments for grading. They stated they gave learners quarterly formal tests that are coupled with scores. Summative assessment is recorded for progression purposes. Teachers used summative assessment to provide feedback to parents about their children's progress. This concurs with Bennett's (2011) assertion that summative assessment focuses mainly on the product of learning. In support of the idea is Khoza (2013) who asserts that summative assessment is a summary of formative assessment of the learners' attainments of learning outcomes for grading purposes. This also corroborates with Cele (2009), who states that summative assessment takes place at the end of a lesson, course, semester or year, and it concentrates on marking and recording scores for grading learners.

Mr Beans stated that:

I then assess them quarterly using tests, examinations and assignments. I also assess them at the end of the year. I recorded these assessments for progression purposes.

Mr Francis asserted that:

I use formal assessments by giving them tests, assignments and investigations. This type is recorded because it is used to grade learners.

Miss Peace said:

I let learners write quarterly by giving them tests, projects and assignments in order to grade them.

Miss Nadia stated that:

I give learners assignments, investigations and other forms of assessments like examinations and I award learners with marks.

The above teachers' accounts seem to suggest that they understood assessment differently, yet they were teaching the same subject and content. The teachers mentioned different kinds of assessments. They found it difficult to differentiate between CASS marks and the end-of-year examinations, tests, projects, assignments and investigations that form the SBA component (DBE, 2011). If teachers do not have a common understanding of assessment, the misconceptions affect assessment procedures and the assessment of learners in generalised. Consequently, the different misinterpretations led to the ineffective implementation of assessment of fractions.

During the interviews it transpired that these teachers were not following Bloom's taxonomy model of assessment. This suggested that the assessment of learners was compromised. Bloom's taxonomy is an organisation of learning objectives within education that teachers set for learners to achieve (Omar, Haris, Hassan, Arshad, Rahmait & Zaina et al., 2012). It is important when developing the assessment task because it explains the cognitive level of an activity for the learner so as to achieve the learning outcome (Khoza, 2013). Teachers should set their formal tasks such that it addresses the four cognitive levels: knowledge 25%, routine procedures 45%, 20% complex procedures and 10% problem solving (DBE, 2011).

However, the findings indicated that teachers stated that they gave learners assignments, projects, tests, examinations and investigations that did not necessarily cater for the four levels as articulated in Bloom's taxonomy. The collection of different sets of assessment used in generating marks for grading learners without any formative assessment element that help learners with feedback is called continuous assessment (Kennedy et al., 2006). In short, continuous assessment is the combination of both formative and summative assessment. This also corroborated by Hoadley and Jansen (2013) that continuous assessment is the assessment

that takes place at breaks throughout the period of learning. This suggests that continuous assessment is made up of all formal recorded tasks, which form CASS marks for Mathematics. According to the DBE (2011) the formal assessment of Mathematics in the intermediate phase comprises SBA (75%) and an end-of-year examination (25%). This suggests that tests, quarterly examinations, projects, assignments and investigations are formal assessments that add to the CASS component of 75%. Therefore, teachers should have the same interpretation of "assessment" in order to implement it effectively.

4.3 Chapter summary

This chapter discussed the findings and analysed data generated through reflective activity, the semi-structured interviews and a focus group interview with four school teachers who are teaching fractions to Grade 6 learners. The findings were then analysed and discussed through the lens of curricular spider-web and literature reviews chosen for this study.

The following chapter provides a summary of the entire study and an interpretation of the conclusions derived, and it ends with the recommendations drawn from the findings associated with the key research questions.

CHAPTER FIVE
STUDY SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

In the previous chapter I presented the data, analysed the data and discussed the data that were generated. The focus of this chapter is to provide a summary, conclusions and recommendations of this study. Conclusions serve to answer the critical questions of this study following the themes from the curricular spider-web. Finally, the chapter suggests recommendations for further research on the basis of the study's results.

5.2 Study summary

The aim of this study was to explore teachers' experiences of teaching fractions to Grade 6 learners in a rural primary school. The study attempted to understand how teachers teach fractions to Grade 6 learners in a rural primary school and why teachers have particular experiences when doing so.

5.2.1 Chapter one

This chapter discussed the background to the study, where the problem was that teachers experience challenges when teaching fractions to Grade 6 learners. A rationale for the importance of the study was provided, and this led into the aims of the study.

The objectives of the study were outlined in section 1.6 as:

1.6.1 To explore teachers' experiences of teaching fractions in Grade 6 CAPS.

1.6.2 To understand how teachers teach fractions in Grade 6 CAPS.

1.6.3 To understand why teachers have particular experiences of teaching fractions in Grade 6 CAPS.

Followed by the critical research questions in section 1.7, as:

1.7.1 What are the teachers' experiences of teaching fractions in Grade 6 CAPS?

1.7.2 How are teachers teaching fractions in Grade 6 CAPS?

1.7.3 Why do teachers have particular experiences of teaching fractions in Grade 6 CAPS?

Lastly, the limitations of the study were also indicated in this chapter.

5.2.2 Chapter two

This chapter located the existing literature on curriculum, Mathematics curriculum reforms in South Africa, the challenges of Mathematics teaching in South Africa, the concept of fractions, and teachers' experiences of teaching fractions. Subsequently, 10 concepts of the curricular spider-web were used as themes that organised the literature reviewed. Concepts of the curricular spider-web form the conceptual framework of this study.

5.2.3 Chapter three

This chapter provided the research methodology that was followed in answering the critical research questions. A qualitative research methodology within the interpretive paradigm was chosen because of its strength in affording participants space to express their experiences more freely. The research was a case study of one primary school offering Mathematics. Four Mathematics teachers were involved in the study through purposive and convenience sampling.

Criteria for the selection involved these teachers being Mathematics teachers teaching Grade 6 learners, their experience, their specialisation in Mathematics, and their accessibility. The study used a reflection activity, semi-structured interviews and a focus group discussion to generate data. In addition, this chapter took into consideration credibility (truth value), transferability (applicability), dependability (consistency) and conformability (neutrality) to enhance the trustworthiness of the study. This chapter also considered data analysis, ethical issues and the limitations of the study.

5.2.4 Chapter four

This chapter offered and discussed the findings of the data generated. This was completed through a guided analysis following the 10 concepts of the curricular spider-web. These concepts created the themes around which the data were discussed in order to explore and understand teachers' experiences of teaching fractions to Grade 6 learners, so that the teachers could grow through their practical involvement in this research and hopefully gain some insights into different perspectives on the teaching of fractions.

5.3 Major findings

Conclusions resulting from the findings will be discussed following the concepts of the curricular spider-web as the themes that organised these teachers' experiences of teaching fractions to Grade 6 learners in a rural primary school.

5.3.1 Rationale

The rationale of teaching any subject could be based on personal rationale, societal rationale and content knowledge rationale (Berkvens et al., 2014). These teachers were teaching fractions because they have passion for teaching them. This showed the personal rationale as the most influential rationale that drives teachers to teach their subject successfully (Khoza, 2015a). It encouraged them to engage in a quest to expand their mathematical knowledge to effectively teach fractions (Ball et al., 2005). If the teachers were directed by the societal rationale, they were committed to their work of teaching fractions. Findings revealed that it is the societal rationale that influenced teachers' experiences of teaching fractions.

Given the prescriptive nature of the curriculum, these teachers were battling to reconcile the personal and societal rationales. When they were guided by the content rationale, they considered that they must be knowledgeable about fractions in order to effectively teach them. They took their teaching as a professional obligation and were driven by knowledge to attain curricular aim, particularly the teaching of fractions. In addition, the findings revealed that these teachers were not aware that they were guided by any rationale in their teaching. The awareness of rationale promotes a good connection between theory and practice (Khoza, 2013). Fostering rationale engages teachers to talk and question curriculum ideology in order to plan for teaching.

5.3.2 Goals

The findings indicated that teachers did not know the difference between aims, objectives and learning outcomes. The teachers find it hard to differentiate between aims, objectives and learning outcomes when teaching fractions. They struggled to plan for fractions in light of the misconceptions that they had about aims, objectives and learning outcomes. Furthermore, the literature concurs with the research findings in stating that goals are important when teaching fractions. Kennedy et al. (2006) and Khoza (2013) believe that teachers must identify long-term goals (aims), during short-term goals (objectives) and what learners will know, understand and be able to demonstrate after the completion of learning or individual

subject/course (learning outcomes). This suggests that teachers must not deny goals when teaching fractions. They remain with an obligation to recognise aims, objectives and learning outcomes in their practices in order to teach effectively.

In addition to the above, the aims in CAPS are both general and specific to subject. It is also not clear whether or not the aims are appropriate for teaching fractions. Aims and objectives in education monitor decisions on the content of subjects and whether there is attainment of these aims (Berkvens et al., 2014). Kennedy et al. (2006) corroborate the importance of aims and says that they regulate the content being taught.

5.3.3 Content

The literature outlined that in order for teachers to teach fractions, teachers should be familiar with the content of fractions as outlined in the curriculum (Bush, Kiggundu & Moorosi, 2011). This is corroborated by Hoadley and Jansen (2013), who say that teachers must know all the topics of the subject that they are teaching in order to yield good results when teaching fractions. These teachers' explanations revealed that their knowledge, beliefs, ideas and previous experiences in teacher education influenced how they teach (Loucks-Horsely et al., 2003).

The prescriptive nature of the curriculum negated the teachers' autonomy regarding content. This is corroborated by Msibi and Mchunu (2013), who say that CAPS is a content-driven curriculum that has detailed explanations for teachers to follow. This indicates that teachers were expected to operate like machines when teaching the fractions within the specified time-frame. This was found to hinder teachers, even those who have years of experience in teaching Mathematics. Therefore, innovative ways of teaching fractions were discouraged.

5.3.4 Teaching activities

The findings indicate that teachers used different activities, including demonstrations on concrete objects when teaching fractions. These activities took consideration of learners' home backgrounds (Ball, 1990). This is supported by Zulu (2013), who says that learners need to be taught using what is known from their cultural backgrounds. This is generally based on the belief that it is advantageous for learners to be allowed to move from the concrete to the abstract. The use of concrete objects encourages more abstract thinking when teaching fractions. The findings also indicate that teachers used different activities when

teaching fractions because learners were different in terms of grasping fractions. The activities that teachers used were both learner-centred and subject-centred. However, the teaching of fractions through a learner-centred activities approach yielded good results (Qazi & Rawatt, 2014).

5.3.5 Teacher role

The findings revealed that these teachers understood their roles as facilitators and instructors. A teacher is a facilitator who creates a classroom environment that is conducive to learners being able to make sense of the knowledge, skills and values being taught in fractions (Landsberg, 2005). Learner-centred education suggests that human beings learn by actively constructing and assimilating knowledge rather than passively adding discrete facts to an existing store of knowledge (Kouwenhoven, 2010). Teachers as instructors concentrate on the content that they teach and on what they "do best" in teaching. This instructionist's view of teaching is corroborated by Kember and Kwan (2002), who say that teachers as instructionists believe that learning is the direct result of having been taught. Thus, teachers decide which role to assume when teaching fractions in the CAPS system.

5.3.6 Resources

According to the findings, teachers were using different resources. Teachers took into consideration that they must use resources that were available to enable leaners' learning of fractions. This is corroborated by Van den Akker et al. (2009), who say that resources are mainly taught at the micro (school) level, where the teachers select which materials to use when they teach. The most common form of curriculum materials (resources) used throughout the world are textbooks (Remilard & Heck, 2014). Textbooks greatly assist the teachers, not only with daily lesson planning, but also with achieving curriculum coverage (Taylor, 2008).

These teachers' experiences of teaching fractions were hampered by the shortage of mathematics textbooks. Prinsloo (2007) says that the lack of resources is one of the major barriers to smooth curriculum implementation in South Africa. Data findings also indicate that the DBE created workbooks as supplementary study material for learners. Some grades were experiencing a shortage of workbooks because the DBE tends to work on the previous years' statistics regarding the number of learners in each grade. The shortage of workbooks impeded the teaching of fractions.

5.3.7 Grouping

The findings revealed that the shortage of resources plays an important role because teachers were forced to group their learners to give them equal access the resources. These groups were too big for a "normal" fractions class, which requires one-on-=one attention from teachers. These teachers were facing problems due to insufficient floor space between the groups and were unable to pay attention to each group. This signified that overcrowded classes were beyond the abilities of teachers to manage. This is supported by Khan and Iqbal (2012), who say that the majority of teachers face instructional and discipline problems in overcrowded classes, which affect teachers' class performance.

The data findings from the teachers indicated that their experiences of teaching fractions were beset by different contextual factors. The unavailability of furniture hampered their efforts, and the classroom conditions were not conducive for the effective teaching and learning of fractions. The findings also revealed that teachers were teaching many subjects and were obliged to change their lessons even if the learners had not mastered the fractions.

The findings also revealed that learners had attitudes towards fractions that were based on anxiety, fear and motivation. Teachers believed that the sense of discomfort observed in learners when learning fractions was associated with fear (Ma, 2003). The fear caused low self-esteem, disappointment and learning failure (Tobias, 1998). One of the factors attributable to anxiety about fractions was a lack of confidence that resulted to reduced levels of motivation (Hlalele, 2012). According to the teachers, they were fighting a "losing battle" in trying to change learners' attitudes towards fractions. The language of teaching was highlighted as a barrier to convey meaning of fractions (Hurrel, 2013).Teachers were worried about the effect of the teaching language, especially as learners experience difficulty with fractions.

5.3.8 Time and location

The findings indicated that parents were not interested in the learning of their children. Teachers' accounts revealed that learners were not receiving support from parents because of the school's rural context. However, the DBE (2011) states that teachers should possess knowledge of different contexts.

The findings also indicated that the time allocated for Mathematics was not sufficient for the teaching of fractions. The teachers indicated that they occasionally use extra teaching time in the morning to cover fractions. The provision for teaching time on fractions in terms one and two is 20 hours, and in terms three and four 10 hours (DBE, 2011). This is supported by Msibi and Mchunu (2013), who say that CAPS spells out exactly what teachers need to cover in each term and prescribes the number of weeks for each topic.

5.3.9 Assessment

The findings indicated that the teachers were guided by CAPS documents on how to assess fractions. Teachers stated that they use both informal (formative) and formal (summative) assessments (Khoza, 2015a). "Formative assessment" is part and parcel of the teaching and learning process (McPhail & Halbert, 2010). It is done informally to evaluate learners' progress and is not planned for grading purposes. "Summative assessment" is done formally and is planned for grading purposes. This concurs with Bennett's (2011) assertion that summative assessment focuses mainly on the product of learning.

The findings from teachers seem to suggest that teachers understood assessment differently even though they were teaching the same content at the same school. Differences in interpretation will lead to poor performance in the implementation of assessment of fractions. Teachers gave learners assessments that did not necessarily cater for the four cognitive levels as articulated in Bloom's taxonomy.

5.4 Implications for further research

This study has implications for further research because:

- The literature review indicated that there are few studies on teachers' experiences of teaching fractions to Grade 6 learners within the CAPS context in Africa.
- Studies can therefore be carried out on curricular spider-web concepts like time, location and teachers' roles, as these were not covered by the literature review.
- Follow-up research on teachers' experiences of teaching fractions to Grade 6 learners (CAPS) is needed to correct teachers who continue to use the same methods and activities that they were taught in their schooling despite changes to the curriculum.
- Studies on the use of mother-tongue instruction for the teaching of fractions are also needed.

5.5 Recommendations

5.5.1 Recommendation 1

These teachers were not aware that they were guided by a vision when teaching fractions. It is recommended that curriculum developers involve teachers in designing the intended curriculum so that teachers will implement the curriculum effectively. The DoE and school management team must support teachers with on-going professional development so that they are kept abreast of new teaching methods and other innovations.

5.5.2 Recommendation 2

These teachers were not aware that CAPS has aims, objectives and learning outcomes. As a result, they found it hard to differentiate between aims, objectives and learning outcomes when teaching fractions. The CAPS method does not specify the objectives per subject; instead it indicates the general aims for all subjects from Grades R to 12. If teachers are not clear about goals, the chance that the teaching of fractions will be successful is slim. Thus, the DoE should clearly state the aims, objective and learning outcomes of Mathematics. The subject advisors should also organise workshops that address the issue of goals towards the teaching of fractions.

5.5.3 Recommendation 3

The prescriptive nature of the curriculum does enable a degree of interpretation on the part of the teachers, but their autonomy is non-existent. It is recommended that teachers should be involved in all levels of curriculum implementation so that they will be well-versed with the content. The DoE must elucidate that the CAPS system is a performance-based, content-driven curriculum, and that teachers must teach it according to the prescribed content.

5.5.4 Recommendation 4

These teachers used the activities that they were familiar with and had used before. They were teaching using the approaches that they were taught. I think that something should be done to promote creativity in teachers. Policymakers should also support teachers by showing them how to create other activities.

5.5.5 Recommendation 5

These teachers were applying many approaches when teaching fractions, which included a teacher-centred-approach and facilitation. This suggests that teachers find it difficult to shift

from a competence curriculum to CAPS, which is based on performance. CAPS is content-driven, and teachers play a leading role. The DoE should define the role of teachers in the CAPS system.

5.5.6 Recommendation 6

The findings were that there was a great lack of resources for teachers, which detracted from their ability to teach fractions. School managers need to take care of ordering and supplying resources so that the teaching of fractions can be effective. It is necessary that the DoE provides schools with electricity, Internet facilities so that teachers can download aids, and information technology resources.

5.5.7 Recommendation 7

The shortage of resources forced these teachers to group their learners to give them access to the available resources. It is recommended that the DoE provides schools with classrooms so that the teachers are able to teach more effectively. In addition, there was not sufficient furniture to allow teachers to apply seating plans for particular activities. The DoE should deal with overcrowded classes by employing more teachers and building more schools. The school managers should order furniture and maintain the classrooms to enable more effective teaching.

5.5.8 Recommendation 8

Parents were not supporting the learners with their homework because of the school's rural context. It is recommended that teachers should possess the knowledge of different contexts (DBE, 2011).

The time provided for the teaching of fractions was not sufficient and teachers occasionally use extra teaching time in the morning to cover fractions. It is recommended that the policymakers assist teachers to utilise their instructional time to teach fractions efficiently.

5.5.9 Recommendation 9

The DoE should ensure that teachers all have the same definition of "assessment" in order to teach the same content at the same school. This creates a need for in-service training.

5.6 Conclusion

This chapter was devoted to drawing together the findings of this research using the concepts of the curricular spider-web. As a result, this chapter included a summary of the research inquiry and the pertinent findings were indicated. Next I outlined the suggestions for further research. Lastly, I formulated achievable recommendations from each curriculum spider-web concept.

References

Abbott, J. (2010). *Overschooled but undereducated*. London: Continuum.

Aboulsoud, S.H. (2011). Formative versus summative assessment. *Education for Health, 24*(2), 651.

Australian Curriculum Assessment and Reporting Authority. (2011). *National assessment programme: literacy and numeracy.* Retrieved April 27, 2011, from http/www.nap.edu.au/.

Adu, E.O. & Ngibe, N.C. (2014). Continuous change in curriculum: South African teachers' Perceptions. *Mediterranean Journal of Social Sciences, 5*(23), 983.

Afari, E., Aldridge, J.M., Fraser, B.J. & Khine, M.S. (2013). Students' perceptions of the learning environment and attitudes in game-based mathematics classrooms. *Learning Environments Research, 16*(1), 131-150.

Alajmi, A.H. (2012). How do elementary textbooks address fractions? A review of mathematics textbooks in the USA, Japan, and Kuwait. *Educational Studies in Mathematics, 79*(2), 239-261.

Ali, M.M. (2012). Revisiting English Language Teaching (ELT) curriculum design: How appropriate is the Bangladesh higher dsecondary level national ELT curriculum as a learner-centred one? *IIUC Studies, 7*, 283-296.

Altinyelken, H.K. (2010). Curriculum change in Uganda: Teacher perspectives on the new thematic curriculum. *International Journal of Educational Development, 30*(2), 151-161.

Association of Mathematics Education of South Africa. (2000). *Minutes of the Primary Mathematics Working Group Session.* Bloemfontein, South Africa.

Amunga, J.J. & Musasia, A.M. (2011). Disparities in mathematics achievement among secondary schools: the case of Kenya. *Problems of education in the 21st Century, 28*8-18.

Anderson, J. (2009). Mathematics curriculum development and the role of problem solving. In *Proceedings of 2009 Australian Curriculum Studies Association National Biennial Conference. Curriculum: A National Conversation* (pp. 1-8). Sydney: Deakin University.

Andrews, P. (2007). The curricular importance of mathematics: a comparison of English and Hungarian teachers' espoused beliefs. *Journal of Curriculum Studies, 39*(3), 317-338.

Arnott, A., Kubeka, Z., Rice, M. & Hall, G. (1997). *Mathematics and Science teachers:demand, utilisation, supply and training in South Africa.* Craighall, South Africa:EduSource.

Atweh, B. & Goos, M. (2011). The Australian mathematics curriculum: A move forward or back to the future? *Australian Journal of Education, 55*(3), 214-228.

Azim, D.S. (1995). *Preservice elementary teachers' understanding of multiplication involving fractions*. Unpublished doctoral dissertation, Washington State University.

Babbie, E. (2004). *The practice of social research*. Belmont: Thomson and Wadworth.

Ball, D.L. (1990). Prospective elementary and secondary teachers' understanding of division. *Journal for Research in Mathematics Education, 21*, 132-144.

Ball, D.L., Bass, H., Hill, H. & Schilling, S. (2005). Developing measures of mathematical knowledge for teaching. Paper presented at the Teachers Development Group Leadership Seminar, Portland, OR. Retrieved 15 July 2014, from http://www.personal.umich.edu/~dball/presentations/021805-TDG-measures.pdf.

Ball, D.L. & McDiarmid, G.W. (1990). The subject matter preparation of teachers. In W.R. Houston, M. Harberman & J. Sikula (Eds.). *Handbook of research on teacher education* (pp. 437-449). New York: McMillan.

Ball, D.L., Thames, M.H. & Phelps, G. (2008). Is content knowledge for teaching what makes it special? *Journal of Teacher Education, 59*(5), 389-407.

Baloch, Q.B. (2011). Writing of a research proposal. *Abasyn University Journal of Social Sciences*, *4*(1).

Bansilal, S., Brijlall, D. & Mkhwanazi, T. (2014). An exploration of the common content knowledge of high school mathematics teachers. *Perspectives in Education*, *32*(1), 30.

Barusch, A., Gringeri, C. & George, M. (2011). Rigor in qualitative social work research: A review of strategies used in published articles. *Social Work Research*, *35*(1), 11-19.

Baxter, P. & Jack, S. (2008). Qualitative case study methodology: Study design and implementation for novice researchers. *The Qualitative Report, 13*(4), 544-559.

Behr, M.J., Lesh, R., Post, T.R. & Silver, E.A. (1983). *Rational number concepts. Acquisition of mathematics concepts and processes*, pp. 91-126. New York: Academic Press.

Bennett, R.E. (2011). Formative assessment: A critical review. *Assessment in Education: Principles, Policy & Practice*, *18*(1), 5-25.

Bennie, K. & Newstead, K. (1999). Obstacles to implementing a new curriculum. In *Proceedings of the National Subject Didactics Symposium* (pp. 150-157). University of Stellenbosch: South Africa.

Berkvens, J., Van den Akker, J. & Brugman, M. (2014). *Addressing the quality challenge: reflections on the post-2015 UNESCO education agenda*. Netherlands National Commission for UNESCO.

Bertram, C. & Christiansen, I.M. (2014). *Understanding research: An introduction to reading research.* Pretoria: Van Schaik.

Bertrand, I. & Hughes, W.P.T. (2005). *Media research methods: audiences, institutions, texts*. New York: Palgrave Macmillan.

Bitsch, V. (2005). Qualitative research: A grounded theory example and evaluation criteria. *Journal of Agribusiness, 23*(1), 75-91.

Black, P. & William, D. (2009). Developing the theory of formative assessment. *Educational Assessment, Evaluation and Accountability (formerly: Journal of Personnel Evaluation in Education), 21*(1), 5-31.

Borko, H., Eisenhart, M., Brown, C.A., Underhill, R.G., Jones, D. & Agard, P.C. (1992). Learning to teach hard mathematics: Do novice teachers and their instructors give up too easily? *Journal for Research in Mathematics Education*, 194-222.

Borko, H. & Putnam, R.T. (1996). Learning to teach. D.C. Berliner & R.C. Callfee (Eds.). *Handbook of educational psychology* (pp. 673-708). New York: Macmillan.

Borkum, E. (2012). Can eliminating school fees in poor districts boost enrollment? Evidence from South Africa. *Economic Development and Cultural Change, 60*(2), 359-398.

Boud, D., Keogh, R. & Walker, D. (1985). *Reflection: Turning learning into experience*. London: Kogan Page.

Braslavsky, C. (2003). *The curriculum*. International Bureau of Education (IBE/UNESCO), Geneva.Retrievedfromhttp://www.ibe.unesco.org/fileadmin/user_upload/archive/AIDS/doc/cecilia_e. pdf.

Brijlall, D. (2014). Exploring practical work as a sustainable strategy in rural mathematics classrooms: a case of addition of fractions. *International Journal of Science, 7*(3), 481-490.

Bush, T., Kiggundu, E. & Moorosi, P. (2011). Preparing new principals in South Africa: the ACE: School leadership Programme. *South African Journal of Education*, *31*(1), 31-43.

Cai, J., Perry, B., Wong, N.Y. & Wang, T. (2009). *What is effective teaching: A study of experienced mathematic teachers from Australia.* Rotterdam: University of Hamburg.

Carin, A., Bass, J. & Contant, T.L. (2005). *Teaching science as inquiry*. Upper Saddle River, New Jersey: Pearson Prentice Hall.

Carl, A.E. (2010). *Teacher empowerment through curriculum development: Theory into practice*. Cape Town: Juta and Company Ltd.

Carnoy, M., Chisholm, L. & Chilisa, B. (2012). *The low achievement trap.* Pretoria: Human Sciences Research Council Press.

Cavanagh, M. (2011). Students' experiences of active engagement through co-operative learning activities in lectures. *Active Learning in Higher Education*, *12*(1), 23-33.

Cele, N.H. (2009). *An investigation into the implementation of formative assessment in Grade seven Natural Science: A case study of three primary schools in the Umlazi District.* A dissertation submitted in partial fulfillment of the requirements for the Master of Education in the faculty of education: Curriculum Studies, unpublished, University of KwaZulu-Natal, Durban.

Charmaz, K. (2006). *Constructing grounded theory: A practical guide through qualitative research.* London: Sage Publications Ltd.

Chenail, R.J. (2011). Interviewing the investigator: Strategies for addressing instrumentation and researcher bias concerns in qualitative research. *The Qualitative Report*, *16*(1), 255-262.

Chinyoka, M., Mutambara, L.H. & Chagwiza, C.J. (2012). Teaching fractions at ordinary level: A case study of mathematics secondary school teachers in Zimbabwe. *Educational Research and Reviews*, 12(4), 1-90.

Christiansen, I., Bertram, C. & Land, S. (2010). Understanding research. *Pietermaritzburg: UKZN Faculty of Education*.

Churton, M. (2000). *Theory and Method.* Southern Asia, Malaysia: Macmillan Press.

Clarke, A. (2003). Characteristics of co-operating teachers. *Canadian Journal of Education/Revue canadienne de l'education*, *26*(2), 237-256.

Clarke, D.M., Clarke, D.J. & Sullivan, P. (2012). Reasoning in the Australian curriculum: Understanding its meaning and using the relevant language. *Australian Primary Mathematics Classroom*, *17*(3), 28.

Cobb, P. & Jackson, K. (2011). Towards an empirically grounded theory of action for improving the quality mathematics teaching at scale. *Mathematics Teacher Education and Development*, *13*(1), 6-33.

Coetzee, A. (2012). *The South African school's curriculum from NCS to CAPS*. Address delivered at a seminar, 31 May 2012, University of South Africa, Pretoria.

Coetzee, M.J.J. (2009). *An exploration of effective classroom management in three different phases of a primary school in a small town in southern KwaZulu-Natal.* Unpublished medical thesis, University of KwaZulu-Natal, School of Education, Durban.

Coffey, M. (2011). Rising to the numeracy challenge. *Adults Learning*, *22*(10), 30-31.

Cohen, M. (2010). T.H. Marshall's "Citizenship and Social Class". *Dissent*, *57*(4), 81-85.

Cohen, L., Manion, L. & Morrison, K. (2007). *Research methods in education* (6th ed.). London: Routledge.

Cohen, L., Manion, L. & Morrison, K. (2011). *Research methods in education* (7th ed.). Milton Park: RoutledgeFalmer.

Cohrssen, C., Church, A. & Tayler, C. (2014). Pausing for learning: Responsive engagement in mathematics activities in early childhood settings. *Australasian Journal of Early Childhood*, *39*(4), 95-102.

Collins, J.W. & O'Brien, N.P. (Eds.). (2011). *The Greenwood dictionary of education*. Ireland: ABC-CLIO.

Collocott, P., Gerrard, D.P. & Maharaj, K. (2013). *Shuter's primer mathematics.* South Africa: Shuter & Shooter Publishers.

Collopy, R. (2003). Curriculum materials as a professional development tool: How a mathematics textbook affected two teachers' learning. *The Elementary School Journal*, *103*(3), 287-311.

Connelly, F. M., & Clandinin, D. J. (1999). *Shaping a professional identity: Stories of educational practice*. London, ON: Althouse Press Teachers College Press.

Crespo, S. & Nicol, C. (2006). Challenging preservice teachers' mathematical understanding: The case of division by zero. *School Science and Mathematics*, *106*(2), 84-97.

Creswell, J.W. (2005). *Qualitative inquiry and research design: Choosing among five approaches* (2nd ed.). Thousand Oaks, CA: Sage Publications.

Creswell, J.W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches*. Thousand Oaks, CA: SAGE Publications, Incorporated.

Creswell, J.W. (2010). Mapping the developing landscape of mixed methods research. In A. Tashakkori & C. Teddlie (Eds.), *SAGE handbook of mixed methods in social & behavioral research* (vol. 2, pp. 45-68). Thousand Oaks, CA: Sage Publications.

Creswell, J.W. (2012). *Educational research: Planning, conducting and evaluating quantitative and qualitative research* (4th ed.). Boston: Pearson.

Crooks, T.J. (2010). Classroom assessment in policy context (New Zealand). In In B. McGraw, P. Peterson & E.L. Baker (Eds.). *The international encyclopedia of education* (pp. 443-448). Oxford, UK: Elsevier

Crowe, S., Cresswell, K., Robertson, A., Huby, G., Avery, A. & Sheikh, A. (2011). The case study approach. *BMC Medical Research Methodology*, *11*(1), 100.

Curriculum Council, Western Australia. (1998). *Curriculum framework for kindergarten to year 12 education in Western Australia*. Osborne Park, WA: Author.

Darling-Hammond, L. & Bransford, J. (2005). Preparing teachers for a changing world: Report of the Committee on Teacher Education of the National Academy of Education. *Phi Delta Kappan*, *28*(2), 8-15.

Dawson, J. (2009). Thick Description. In A.J. Mills, G. Durepos & E. Wiebe (Eds.), *Encyclopedia of Case Study Research.* Thousand Oaks, CA: SAGE Publications. Denzin, N.K. & Lincoln, Y.S. (2005). *The Sage handbook of qualitative research* (3rd ed.). London: Sage Publications.

Denzin, N.K. & Lincoln, Y.S. (2008). *Collecting and interpreting qualitative materials*. London: Sage.

Denzin, N.K. & Lincoln, Y.S. (2011). *The SAGE handbook of qualitative research*. London: Sage.

Department of Basic Education. (2010). *Annual National Assessment 2011. A guideline for the interpretation and use of ANA results*. Pretoria: Department of Basic Education.

Department of Basic Education. (2011). *Curriculum and Assessment Policy Statement* (CAPS). *Intermediate-phase (4-6): Mathematics*. Pretoria: Department of Basic Education.

Department of Basic Education. (2011). *Report on the Annual National Assessments of 2011*. Pretoria: Department of Basic Education.

Department of Basic Education (2012). *National protocol for assessment grades R-12.* Pretoria: Government Printers. Retrieved from http//www.education.gov.za.

Department of Basic Education (2013). *Ministerial task team: Investigation into the implementation of Maths, Science and Technology*. Pretoria: Department of Basic Education.

Department of Education. (2008). *The Revised National Curriculum Statement (RNCS) for General Education and Training (GRADES R-9) and National Curriculum Statement for Grades 10-12*. Pretoria: Government Printer.

Department of Education. (2009). *National curriculum statement grade 10-12*. Pretoria. Government Printer.

Department of Education & Training, Western Australia. (2007). *Mathematics syllabus*. Perth, Western Australia: DETWA.

De Vries, M. (2014). *The role of the foundation phase teacher in facilitating multiple intelligences in the classroom.* A dissertation submitted in accordance with the requirements for the Master of Education in Inclusive Education, University of South Africa, South Africa. Available from http//hdl.handle.net/10500/14237.

Dewey, J. (1960). *How we think: A restatement of the relation of reflective thinking to the educational process*. Chicago, D.C.: Health.

Di Martino, P. & Zan, R. (2010). 'Me and maths': towards a definition of attitude grounded on students' narratives. *Journal of Mathematics Teacher Education*, *13*(1), 27-48.

Dotterer, A.M. & Lowe, K. (2011). Classroom context, school engagement, and academic achievement in early adolescence. *Journal of Youth and Adolescence*, *40*(12), 1649-1660.

Du Plessis, E. (2013). Do teachers receive proper in-service training to implement changing policies: Perspective from the South African case. *Education in One World: Perspectives from Different Nations*, *11*, 53-58.

Empson, S.B. (2003). Low-performing students and teaching fractions for understanding: An interactional analysis. *Journal for Research in Mathematics Education*, *34*(4), 305-343.

Erden, E. (2010). *Problems that preschool teachers face in the curriculum implementation,* Doctoral dissertation, Middle East Technical University.

Ernest, P. (2010). The scope and limits of critical mathematics education. In H. Alro, O. Ravn & P. Valero (Eds.), *Critical Mathematics Education: Past, present and future: Festschrift for Ole Skovsmore* (pp. 65- 87). Rotterdam: Sense Publishers.

Esposito, J. & Swain, A.N. (2009). Pathways to social justice: Urban teachers' uses of culturally relevant pedagogy as a conduit for teaching for social justice. *Penn GSE Perspectives on Urban Education*, *6*(1), 38-48.

Farrokhi, F. & Mahmoudi-Hamidabad, A. (2012). Rethinking convenience sampling: Defining quality criteria. *Theory and Practice in Language Studies*, *2*(4), 784-792.

Fleisch, B. (2008). *Primary education in crisis: Why South African schoolchildren underachieve in reading and mathematics*. Cape Town: Juta and Company Ltd.

Flick, U. (2006). *An introduction to qualitative research*. (3rd ed.). Thousand Oaks. CA: Sage.

Flores, M.A. & Day, C. (2006). Contexts which shape and reshape new teachers' identities: A multi-perspective study. *Teaching and Teacher Education*, *22*(2), 219-232.

Flyvbjerg, B. (2006). Five misunderstandings about case-study research. *Qualitative Inquiry*, *12*(2), 219-245.

Freeman, B. (2012). Using digital technologies to redress inequities for English language learners in the English-speaking mathematics classroom. *Computers & Education*, *59*(1), 50-62.

Gay, L.R., Mills, G.E. & Airasian, P.W. (2009). *Educational research: Competencies for analysis and applications*. Upper Saddle River, NJ: Pearson Higher Ed.

Gibbs, G.R. (2007). *Analyzing qualitative data*. London: Sage Publications Ltd.

Ginsburg, H.P. & Amit, M. (2008). What is teaching mathematics to young children? A theoretical perspective and case study. *Journal of Applied Development Psychology, 29,* 274-285.

Gutstein, E. (2003). Teaching and learning mathematics for social justice in an urban, Latino school. *Journal for Research in Mathematics Education, 34* (1), 37-73.

Gutstein, E. (2012). Connecting community, critical, and classical knowledge in teaching mathematics for social justice. In *Alternative forms of knowing (in) mathematics* (pp. 300-311). Rotterdam, the Netherlands: Sense Publishers.

Hardman, F., Abd-Kadir, J. & Smith, F. (2008). Pedagogical renewal: Improving the quality of classroom interaction in Nigerian primary schools. *International Journal of Educational Development, 28*(1), 55-69.

Harris, A. & Goodall, J. (2008). Do parents know they matter? Engaging all parents in learning. *Educational Research, 50*(3), 277-289.

Harris, J. B., & Hofer, M. J. (2011). Technological pedagogical content knowledge (TPACK) in action: A descriptive study of secondary teachers' curriculum-based, technology-related instructional planning. *Journal of Research on Technology in Education, 43*(3), 211-229.

Hartnett, J.E. (2007). Categorisation of mental computation strategies to support teaching and to encourage classroom dialogue. In J. Watson & K. Beswick (Eds.). *30th annual conference of the Mathematics Education. Research Group of Australasia-Mathematics: Essential Research Practice, 2-6 July 2007*. Horbat: MERGA.

Harvey, R. (2012). Stretching student teachers' understanding of fractions. *Mathematics Education Research Journal, 24*(4), 493-511.

Hatton, N. & Smith, D. (1995). Reflection in teacher education: Towards definition and implementation. *Teaching and Teacher Education, 11*(1), 33-49.

Henning, E. (2004). *Finding your way in qualitative research.* Pretoria: Van Schaik Publishers.

Hewitt, T.W. (2006). *Understanding and shaping curriculum: What we teach and why*. Thousand Oaks: Sage Publications.

Hill, H.C. & Ball, D.L. (2004). Learning mathematics for teaching: Results from California's mathematics professional development institutes. *Journal for Research in Mathematics Education,* 330-351.

Hill, H.C., Rowan, B. & Ball, D.L. (2005). Effects of teachers' mathematical knowledge for teaching on student achievement. *American Educational Research Journal,* 42, 371-406.

Hirsch, C.R. & Reys, B.J. (2009). Mathematics curriculum: A vehicle for school improvement. Zentralblatt fur Didatik der Mathematik, *1*(6), 749-761.

Hlalele, D. (2012). Exploring rural high school learners' experiences of mathematics anxiety in academic settings. *South African Journal of Education, 32*(3), 267-278.

Hoadley, U. & Jansen, J.D. (2012). *Curriculum: Organising knowledge for the classroom*. Cape Town, Oxford University Press Southern Africa.

Hoadley, U. & Jansen, J.D. (2013). *Curriculum: Organising knowledge for the classroom* (3rd ed.). Cape Town: Oxford University Press Southern Africa.

Hoadley, U. & Jansen, J.D. (2014). *Curriculum: Organising knowledge for the classroom*. Cape Town, Oxford University Press Southern Africa.

Hope, J.A. & Owens, D.T. (1987). An analysis of the difficulty of learning fractions. *Focus on Learning Problems in Mathematics, 9*(4), 25–40.

Hong, E., Wan, M. & Peng, Y. (2011). Discrepancies between students' and teachers' perceptions of homework. *Journal of Advanced Academics, 22*(2), 280-308.

Huba, M.E. & Freed, J.E. (2000). Learner-centered assessment on college campuses: Shifting the focus from teaching to learning. *Community College Journal of Research and Practice*, *24*(9), 759-766.

Hugo, A.J. (2008). Primary school teachers' opinions of their ESL learners' language abilities. *Journal of Language Learning*, *42*(2), 63-76.

Hugo, W., Wedekind, V. & Wilson, D. (2010). *The state of education in KwaZulu-Natal: A report to the Provincial Treasury*. Pietermaritzburg: KZN Provincial Treasury.

Hunter, R. (2010). Changing roles and identities in the construction of a community of mathematical inquiry. *Journal of Mathematics Teacher Education*, *13*(5), 397-409.

Hurrell, D.P. (2013). What teachers need to know to teach mathematics: An argument for a reconceptualised model. *Australian Journal of Teacher Education*, *38*(11), n11.

Isiksal, M. & Cakiroglu, E. (2011). The nature of prospective mathematics teachers' pedagogical content knowledge: The case of multiplication of fractions. *Journal of Mathematics Teacher Education*, *14*(3), 213-230.

Izsák, A. (2008). Mathematical knowledge for teaching fraction multiplication. *Cognition and Instruction*, *26*(1), 95-143.

Jacobson, M. & Ruddy, M. (2004). *Open to outcome: a practical guide for facilitating and teaching experiential reflection,* pp. 219-239. Oklahoma, Netherlands: Springer.

Jansen, J. (2002). Political symbolism as policy craft: Explaining non-reform in South African education after apartheid. *Journal of Education Policy, 17*(2), 199-215.

Jansen, J.D. & Christie, P. (1999). *Changing curriculum: Studies on outcomes-based education in South Africa*. Cape Town: Juta and Company Ltd.

Jarabeen, Y. (2009). Building a conceptual framework: philosophy, definitions, and procedure. International Journal of Qualitative Methods, *8*(4), 49-62.

Johnson, N.R. (1998). *A descriptive study of number sense and related misconceptions about selected rational number concepts exhibited by prospective elementary teachers*. Unpublished Doctoral dissertation, University of South Florida.

Jonker, J. & Pennink, P. (2010). *The essence of research methodology: A concise guide for Masters and PhD Students in Management Sciences*. Hiedelburg, Germany: Springer.

Jordan, N.C., Hansen, N., Fuchs, L.S., Siegler, R.S., Gersten, R. & Micklos, D. (2013). Developmental predictors of fraction concepts and procedures. *Journal of Experimental Child Psychology*, *116*(1), 45-58.

Khan, P., & Iqbal, M. (2012). Overcrowded classroom: a serious problem for teachers. *Educational Technology*, *49*, 10162-10165

Kelly, V. (2009). *The Curriculum. Theory and Practice*. London: PCP.

Kember, D. & Leung, D.Y. (2009). Development of a questionnaire for assessing students' perceptions of the teaching and learning environment and its use in quality assurance. *Learning Environments Research, 12*(1), 15-29.

Kember, D. & Kwan, K.P. (2002). Lecturers' approaches to teaching and their relationship to conceptions of good teaching. In N. Hativa & P. Goodyear (Eds.), *Teacher thinking, beliefs and knowledge in higher education* (pp. 8-15). Dordrecht, The Netherlands: Kluwer Academic Publishers.

Kennedy, D., Hyland, A. & Ryan, N. (2006). *Writing and using learning outcomes: A practical guide.* Bologna: European Higher Education Area (EHEA).

Kern, D.E., Thomas, P.A. & Hughes, M.T. (Eds.) (2010). *Curriculum development for medical education: a six-step approach*. Baltimore, Maryland: JHU Press.

Khatoon, T. & Mahood, S. (2010). Mathematics anxiety among secondary school students in India and its relationship to achievement in mathematics. *European Journal of Social Sciences*, 16 (1): 75-86.

Khoza, S.B. (2013). Learning outcomes as understood by "publishing research" facilitators at a South African university. *Mevlana International Journal of Education, 3*(2), 1-11.

Khoza, S. B. (2014). Is chemistry everything to engineering students? Let their experiences talk. *South African Journal of Higher Education*, *28*(2), 1-8.

Khoza, S.B. (2015a). Can Turnitin come to the rescue: From teachers' reflections. *South African Journal of Education*, *35*(4), 1-9.

Khoza, S.B. (2015b). Student teachers' reflections on their practices of Curriculum and Assessment Policy Statement. *South African Journal of Higher Education*, *29*(4), 179-197.

Khuzwayo, B. (2005). A history of mathematics education research in South Africa: The apartheid years. In R. Vithal, J. Adler & C. Keitel (Eds.), *Researching mathematics education in South Africa: Perspectives, practices and possibilities* (pp. 234, 286). Cape Town: HSRC Press.

Khuzwayo, H. (2000). *Selected views and critical perspectives: An account of mathematics education in South Africa from 1948 to 1994*. Unpublished Doctoral dissertation, Aalborg University, Aalborg, Denmark.

Kilpatrick, J., Swafford, J. & Findell, B. (2001). Adding it up. *Mathematics Learning Study Committee, Center for Education.* Washington, DC: National Academy Press.

Kleve, B. Teaching fractions in primary school: How is a teacher's knowledge communicated to pupils? In D. Corcoran, T. Dooley, S.Close & R. Ward (Eds.*), Proceedings of the Third National Conference on Research in Mathematics Education, St Patricks's College, Drumcondra, Dublin, 24 and 25 September, 2009* (p. 144). Retrieved from https://www.spd.dcu.ie/site/maths_ed/documents/MEI3proceedings.pdf

Kong, S.C. (2008). The development of a cognitive tool for teaching and learning fractions in the mathematics classroom: A design-based study. *Computers & Education*, *51*(2), 886-899.

Koro-Ljungberg, M. (2010). Validity, responsibility, and aporia. *Qualitative Inquiry*, *16*(8), 603-610.

Kouwenhoven, W. (2010). Competence-based curriculum development in higher education: Some African experiences. In M. Cantrell, M. Kool & W. Kouwenhoven (Eds.), *Access & Expansion: Challenges for Higher Education Improvement in Developing Countries* (p. 221). Amsterdam, The Netherlands: VU University Press.

Kurz, A. (2011). Access to what should be taught and will be tested: Students' opportunity to learn the intended curriculum. In S.N. Elliott, R.J. Kettler, P.A. Beddow & A. Kurz (Eds.), *Handbook of Accessible Achievement Tests for All Students* (pp. 99-129). New York: Springer.

Kvale, S. & Brinkman, S. (2009). *Interviews: Learning the craft of qualitative interviewing.* (2nd ed). Beverly Hills, California: Sage Publications.

Lam, C.C. & Lidstone, J. (2001). The implementation of a new integrated social science syllabus: Case studies from Brisbane secondary schools. *Education Journal, Hong Kong-Chinese University of Hong Kong*, *29*(2), 61-84.

Lamon, S.J. (2007). Rational numbers and proportional reasoning: Toward a theoretical framework for research. In F. K. Lester, Jr. (Ed.), *Second handbook of research on mathematics teaching and learning* (vol. 1, pp. 629-667). Charlotte, NC: Information Age Publishing.

Landsberg, E. (2005*). Addressing barriers to learning: A South African perspective*. Pretoria: Van Schaik.

Leedy, P.D. & Ormrod, J.E. (2010). *Practical Research: Planning and Design.* Upper Saddle River, New Jersey: Merrick.

Leinhardt, G. & Smith, D.A. (1985). Expertise in mathematics instruction: Subject matter knowledge. *Journal of Educational Psychology*, *77*, 247–271.

Liamputtong, P. (2013). *Qualitative research methods* (4th ed.). Melbourne: Oxford University Press.

Lieberman, A. & Miller, L. (2011). *Teacher leadership* (vol. 17). John Wiley & Sons.

Lincoln, Y. S., & Guba, E. G. (2000). Paradigmatic controversies, contradictions, and emerging confluences, revisited. In N. K. Denzin & Y. S. Lincoln (Eds.). *Handbook of qualitative research*, (2nd ed., 163-188. Thousand Oaks, CA: Sage.

Linnenbrink, E.A. & Pintrich, P.R. (2002). Motivation as an enabler for academic success. *School Psychology Review*, *31*(3), 313.

Liodaki, N. & Karalis, T. (2013). Educational experiences and transformative learning in higher education in Greece: A case study with student teachers. *International Journal of Education*, *5*(2), 75-85.

Long, M. (2004). *A hands-on approach to calculus*. Doctoral dissertation, West Virginia University.

Loucks-Horsely, S., Love, N., Stiles, K., Mundry, S. & Hewson, P.W. (2003). *Designing professional development for teachers of science and mathematics* (2nd ed.). Thousand Oaks, CA: Corwin Press.

Ma, L. (1999). *Knowing and teaching elementary mathematics: Teachers' understanding of fundamental mathematics in China and the United States*. Mahwah, NJ: Lawrence Erlbaum Associates.

Ma, X. (2003). Effects of early acceleration of students in mathematics on attitude and anxiety toward mathematics: The developmental perspective. *The Teachers College Record*, *105*(3), 438-464.

MacMillan, J.H. & Schumacher, J. (2006). *Researcher in Education: Evidence-based inquiry.* (6th ed.) Boston: Pearson.

MacMillan, J.H. & Schumacher, J. (2010*). Researcher in Education* (7th ed.) Boston: Pearson.

McPhail, A. & Halbert, J. (2010). "We had to do intelligent thinking during recent PE": Students' and teachers' experiences of assessment for learning in post-primary physical education. *Assessment in Education: Principles, Policy & Practice*, *17*(1), 23-39.

Maree, K. (2007). *First steps in research*. Pretoria: Van Schaik Publishers.

Maree, K. (2009). *First steps in research.* Pretoria: Van Schaik Publishers.

Maree, K. (2010). *First steps in research.* Pretoria: Van Schaik Publishers.

Maree, K. (2013). *First steps in research*. Pretoria: Van Schaik Publishers.

Marks, R. (1990). Pedagogical content knowledge: From a mathematical case to a modified conception. *Journal of Teacher Education*, *41*(3), 3-11.

Marsh, C.J. & Willis, G. (2007). *Curriculum: Alternative approaches, ongoing issues*. Columbus: Pearson.

Martinie, S. (2005). *Assessing conceptual understanding of rational numbers and constructing a model of the interrelated skills and concepts*. Retrieved 15 July, 2014, from http/www.math.ksu.edu/math791/finalpaper/sherriterm 2.pdf.

Mata, M.D.L., Monteiro, V. & Peixoto, F. (2012). Attitudes towards mathematics: Effects of individual, motivational, and social support factors. *Child Development Research, 12*, 1-10

Maxwell, J.A. (2013). *Qualitative research design: An interactive approach.* Thosand Oaks, CA: Sage.

McDiarmid, G.W. & Wilson, S.M. (1991). An exploration of the subject matter knowledge of alternate route teachers: Can we assume they know their subject? *Journal of Teacher Education, 42*(2), 93-103.

Mdluli, M. (2014). The use of workbooks in South African grade 3 mathematics classrooms. *South African Journal of Childhood Education, 4*(1), 80-94.

Merriam, S.B. (1998). *Qualitative research and case study applications in education: Revised and expanded from case study research in education.* San Fransisco: Jossey-Bass Publishers.

Merriam, S.B. (2002). Introduction to qualitative research. *Qualitative Research In Practice: Examples for Discussion and Analysis, 1*, 1-17.

Merriam, S.B. (2009). *Qualitative research and case study. Applications in education* (2nd ed.). San Francisco: Jossey-Bass Publishers.

Mertens, D.M. (2014). *Research and evaluation in education and psychology: Integrating diversity with quantitative, qualitative, and mixed methods*. Thousand Oaks, CA: Sage Publications.

Mettetal, G. (2012). The what, why and how of classroom action research. *Journal of the Scholarship of Teaching and Learning, 2*(1), 6-13.

Miles, M.B., Huberman, A.M. & Saldaña, J. (2014). Fundamentals of qualitative data analysis. *Qualitative data analysis* (3rd ed.) (pp 69-104). Thousand Oaks, CA: Sage.

Millan, J.L. (2008). *Understanding Curriculum in context: Using currere to explore the perceptions, attitudes and practices of white teachers in classrooms with African learners*. Texas: A &M University.

Miller, S.P. & Hudson, P.J. (2007). Using evidence-based practices to build mathematics competence related to conceptual, procedural, and declarative knowledge. *Learning Disabilities Research & Practice, 22*(1), 47-57.

Ministry of Education. (1992). *Mathematics in the New Zealand Curriculum.* Wellington: Ministry of Education.

Moran, C.E. & Hakuta, K. (1995). Bilingual education: Broadening research perspectives. In J. Banks & C. Banks (Eds.). *Handbook of Research on Multicultural Education* (pp. 445- 462). New York: Simon & Schuster Macmillan.

Morgan, L. (2010). Teacher professional transformation using learning by design: A case study. *E- learning and Digital Media, 12*(3), 279-280.

Morris, A.K., Hiebert, J. & Spitzer, S.M. (2009). Mathematical knowledge for teaching in planning and evaluating instruction: What can preservice teachers learn? *Journal for Research in Mathematics Education, 40* (5), 491-529.

Mouton, J. (2011). *How to succeed in your Masters and Doctoral studies. A South African guide and resources book.* Pretoria: Van Schaik Publishers.

Msibi, T. & Mchunu, S. (2013). The knot of curriculum and teacher professionalism in post-apartheid South Africa. *Education as Change, 17*(1), 19-35.

Msila, V. (2007). From apartheid education to the Revised National Curriculum Statement: Pedagogy for identity formation and nation building in South Africa. *Nordic Journal of African Studies, 16*(2), 146-160.

Nasier, A.E., Wright, W.E. & Capraro, M. (2004). Teaching fractions: Strategies used for teaching fractions in middle grade students, *Journal of Research in Childhood Education, 18*(3), 193-198.

National Center for Research on Teacher Education. (1991). *Findings from teacher education and learning to teach study: Final report.* East Lancing: MI: National Center for Research on Teacher Education.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics.* Reston, VA: Author.

National Mathematics Advisory Panel. (2008). *Foundations for success: The final report of the National Mathematics Advisory Panel*. Washington, DC: US Department of Education.

Nel, J. (1995). From theory to practice: Ogbu and Erickson in the multicultural education curriculum. *Action in Teacher Education, 17*(1), 60-69; 139.

Neuman, W. (2006). Qualitative and quantitative research designs. *WL Neuman, Social research methods: Qualitative and quantitative approaches* (6th ed., pp. 149-178). Boston: Pearson Prentice-Hall.

Neuman, W.L. (2011). *Social Science Methods: Quantitative and Qualitative Approaches*. (7th ed.). Boston: Pearson / Allyn and Bacon.

Newton, K.J. (2008). An extensive analysis of preservice elementary teachers' knowledge of fractions. *American Educational Research Journal, 45*(4), 1080-1110.

National Institute for Educational Development. (2009). The National Institute for Basic Education. Retrieved 15 July, 2012, from http//www.neid.edu. na.

Nieuwenhuis, J. (2007). Analysing qualitative data. In K. Maree (Ed.). *First steps in research*, pp. 99-115. Pretoria: Van Schaik Publishers.

Nieuwoudt, H.D. & Golightly, A. (2006). Constructivism and teacher education: An integrated South African perspective. In B. de Muynck & H. van der Walt (Eds.). *The call to know the world: A view on constructivism and education* (pp. 107-131). Amsterdam: Buijten & Schipperheijn Publishing House.

O'Brien, S. & Brancaleone, D. (2011). Evaluating learning outcomes: In search of lost knowledge. *Irish Educational Studies, 30*(1), 5-21.

Odendahl, N.V. (2011). *Testwise: Understanding educational assessment*, Vol. 1. United Kingdom: R&L Education.

O'Neill, G. and McMahon, T. (2005) Student-centred learning: what does it mean for students and lecturers? In O'Neill, G., Moore, S. and McMullin, B. (Eds), *Emerging issues in the practice of university learning and teaching*. Dublin: AISHE.

Ornstein, A.C. & Hunkins, F.P. (2009). *Curriculum foundations' principles and issues* (5th ed.). Boston: Pearson Education Inc.

Pantziara, M. & Philippou, G. (2012). Levels of students' "conception" of fractions. *Educational Studies in Mathematics, 79*(1), 61-83.

Pape, S.J. & Tchoshanov, M.A. (2001). The role of representation(s) in developing mathematical understanding. *Theory into Practice, 40*(2), 118-127.

Parry, O. & Mauthner, N.S. (2004). Whose data are they anyway? Practical, legal and ethical issues in archiving qualitative research data. *Sociology, 38*(1), 139-152.

Peters, J. (2011). *A mathematics teacher's beliefs and knowledge of Grade 7 learners' problem-solving strategies during a problem-solving task.* Doctoral dissertation, University of Johannesburg.

Pienaar, E. (2014). *Learning about and understanding fractions and their role in the high school curriculum.* Thesis submitted in fulfillment of the requirements for the degree of Master of Education: Curriculum studies (Mathematics Education), Stellenbosch University.

Pinar, W.F. (2014). *Curriculum: Toward new identities*. New York: Routledge.

Pinar, W.F. (2012). *Curriculum studies in the United States: Present circumstances, intellectual histories*. New York: Palgrave Macmillan.

Pithouse, K. (2001). Adapt or die? A teacher's evaluation of a curriculum 2005 "Re-training Workshop": conversations about research. *Perspectives in Education, 19*(1), 154.

Polit, D.F. & Beck, C.T. (2012). *Nursing research: Principles and methods.* Philadelphia, PA: Lippincott Williams and Wilkins.

Pool, R., Montgomery, C.M., Morar, N.S., Mweemba, O., Ssali, A., Gafos, M. & McCormack, S. (2010). A mixed methods and triangulation model for increasing the accuracy of adherence and sexual behaviour data: the Microbicides Development Programme. *PloS One*, *5*(7), e1160.

Porritt, K., Gomersall, J. & Lockwood, C. (2014). JBI's systematic reviews: Study selection and critical appraisal. *American Journal of Nursing*, *114*(6), 47-52.

Porter, A.C. (2006). Curriculum assessment. In J. L. Green, G. Camilli & P. B. Elmore (Eds.), *Handbook of complementary methods in education research* (pp. 141-159). Washington, DC: American Educational Research Association.

Prinsloo, E. (2007). Implementation of life orientation programmes in the new curriculum in South African schools: Perceptions of principals and life orientation teachers. *South African Journal of Education*, *27*(1), 155-170.

Qazi, B.M.I.W. & Rawat, K.J. (2014). The effect of teaching of fractions through a constructivist approach on learning outcomes of public sector primary schools teachers. *Bulletin of Education and Research*, *36*(1), 15-35.

Rammapudi, T.S. (2010). *The Botswana National Museum as an educational resource in public school classrooms*. Doctoral dissertation, University of South Africa.

Rand Afrikaans University (2002). *Guideline on Academics Ethics.* Johannesburg: RAU.

Rauhvargers, A., Deane, C. & Pauwels, W. (2009). *Bologna process stocktaking report.* Retrieved on April 20, 2009, from http://www. ond.vlaanderen.be.

Redmond, B. (2007). *Learning outcomes: Moving from teaching to learning*. Information Seminar on the Gologna Process, "Writing Learning Outcomes", 13 December 2007, Dublin.

Remillard, J.T. (2000). Can curriculum materials support teachers' learning? Two fourth-grade teachers' use of a new mathematics text. *The Elementary School Journal*, 100 (4), 331-350.

Remillard, J.T. & Heck, D.J. (2014). Conceptualizing the curriculum enactment process in mathematics education. Zentralblatt fur Didatik der Mathematik, *46*(5), 705-718.

Rolfe, G. (2006). Validity, trustworthiness and rigour: Quality and the idea of qualitative research. *Journal of Advanced Nursing*, *53*(3), 304-310.

Rule, P. & John, V. (2011). *Your guide to case study research*. Pretoria: Van Schaik.

Russell, D. (2007). A Review of recent research in the area of initial fraction concepts, *Educational Studies in Mathematics, 30*, 5-38.

Rytivaara, A. (2011). Flexible grouping as a means for classroom management in a heterogeneous classroom. *European Educational Research Journal*, *10*(1), 118-128.

Sabzian, F., Ismail, Z., Ismail, S. & Vajargah, K.F. (2013). An evaluation of the effectiveness of teachers' professional development in Iran using the Akker Spider-web Model. *International Journal of Human Resource Studies*, *3*(3), 1.

Salkind, N.J. (2012). *100 questions (and answers) about research methods* (1). Thousand Oaks, CA: Sage Publications.

Samuel, M. (2009). On becoming a teacher: Life history research and the force-field model of teacher development. In R. Dhunpath & M.A. Samuel (Eds). Life history research, epistemology, methodology and representation (pp. 12-12). Rotterdam: Sense Publishers.

Schön, D. (1987). *Educating the reflective practitioner: Toward a new design for teaching and learning in the professions.* San Francisco, CA: Jossey-Bass.

Shenton, A.K. (2004). Strategies for ensuring trustworthiness in qualitative research projects. *Education for Information*, *22*(2), 63-75.

Shulman, L.S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, *15*(2), 4-14.

Silverman, D. (2011). *Qualitative Research* (3rd ed.). London: Sage Publications.
Simkins, C. (2013). *Performance in the South African educational system: What do we know?* Johannesburg: Centre for Development and Enterprise.
Simon, M.K. & Goes, J. (2013). Scope, limitations, and delimitations. *Dissertation and Scholarly Research: Recipe for Success.* Seattle, WA: Dissertation Success LLC.
Smith, M.S. (2000). Balancing old and new: An experienced middle school teacher's learning in the context of mathematics instructional reform. *The Elementary School Journal*, 100 (4), 351-375.
Southwood, S. & Spanneberg, R. (1999). *Rethinking teaching and learning of mathematics*. Pretoria: MC Printers.
Spalding, E., Wilson, A. & Mewborn, D. (2002). Demystifying reflection: A study of pedagogical strategies that encourage reflective journal writing. *The Teachers College Record*, *104*(7), 1393-1421.
Spaull, N. (2011). *A preliminary analysis of SACMEQ III South Africa*. Stellenbosch: Stellenbosch University.
Spaull, N. (2013). Poverty & privilege: Primary school inequality in South Africa. *International Journal of Educational Development*, *33*(5), 436-447.
Stein, M.K. & Kim, G. (2009). The role of mathematics curriculum materials in large-scale urban reform. *Mathematics teachers at work: Connecting curriculum materials and classroom instruction*, pp. 37-55. New York: Routledge.
Sullivan, P. (1987). The impact of a pre-service mathematics education course on beginning primary teachers. Research in Mathematics Education in Australia, August 1-9.
Swan, P. & Marshall, L. (2010). Revisiting mathematics manipulative materials. *Australian Primary Mathematics Classroom*, *15*(2), 13-19.
Taba, H. & Spalding, W.B. (1962). *Curriculum development: Theory and practice* (No. 37.013 TAB). New York: Harcourt, Brace & World.
Thaanyane, M.E. (2010). *Teachers' experiences of implementing Business Education in three secondary schools in Maseru, Lesotho*. Unpublished Medical Thesis, University of KwaZulu-Natal, Faculty of Education, Durban.
Taylor, B.A. & Fraser, B.J. (2013). Relationships between the learning environment and mathematics anxiety. *Learning Environments Research*, *16*(2), 297-313.
Taylor, E.W. (2008). Transformative learning theory. *New Directions for Adult and Continuing Education*, *119*, 5-15.
Tella, A. (2008). Teacher variables as predictors of academic achievement of primary school pupils' mathematics. *International Electronic Journal Environmental Education*, *1*(1), 1-30.
Thambi, N. & Eu, L.K. (2013). Effect of students' achievement in fractions using GeoGebra. *Journal of the Association for Science and Mathematics*, *16*, 97-106.
Thomas, E., & Feng, J. (2014). Effects of Ability Grouping on Math Achievement of Third Grade Students. *Online Submission*. Paper presented at Georgia Educational Research Association Annual Conference, 17-18 October 2014, Savannah, Georgia.
Thomson, S., Hillman, K., Wernert, N., Schmid, M., Buckley, S. & Munene, A. (2012). *Highlights from TIMSS & PIRLS 2011 from Australia's perspective.* Melbourne: Australian Council for Educational Research (Acer).
Tirosh, D. (2000). Enhancing prospective teachers' knowledge of children's conceptions: The case of division of fractions. *Journal for Research in Mathematics Education*, *31*(1), 5-25.
Tobias, J.M. (2013). Prospective elementary teachers' development of fraction language for defining the whole. *Journal of Mathematics Teacher Education*, *16*(2), 85-103.
Tobias, S. (1998). Anxiety and mathematics. *Harvard Education Review*, *50*, 88-97.

Toluk-Uçar, Z. (2009). Developing pre-service teachers understanding of fractions through problem posing. *Teaching and Teacher Education*, *25*(1), 166-175.

Tomlinson, C.A. (2010). Learning to love assessment. *Educational Foundations: An Anthology of Critical Readings*, p. 187. Thousand Oaks, CA: Sage Publishers.

Tracy, S.J. (2013). *Qualitative research methods: Collecting evidence, crafting analysis, communicating impact.* West Sussex: Blackwell Publishing.

Tshiredo, L.L. (2013). *The impact of the curriculum change in the teaching and learning of science: A case study in under-resourced schools in Vhembe District*. University of South Africa, Pretoria, retrieved from http//hdl.handle.net/10500/11893.

Ulin, P.R., Robinson, E.T. & Tolley, E.E. (2012). *Qualitative methods in public health: A field guide for applied research*. New York: John Wiley & Sons.

Valli, L. (2009). Listening to other voices: A description of teacher reflection in the United States, *Peabody Journal of Education, 72*(1), 67-88.

Van den Akker, J., de Boer, W., Folmer, E., Kuiper, W., Letschert, J., Nieveen, N. & Thijs, A. (2009). *Curriculum in development*. Enschede: Netherlands Institute for Curriculum Development.

Van Niekerk, L. (2012). *Pocket guide to South Africa 2011/2012*. Government Communication and Information. Retrieved 15 November, 2010, from http/www.gcis.gov.za/sites/default/files/docs/resourcecentre/pocketguide/017 education. pdf.

Venkat, H. (2013). Curriculum development minus teacher development ≠ mathematics education. In Z. Davis & S. Jaffer (Eds.), *Proceedings of the 19th Annual National Congress of the Association for Mathematics Education of South Africa*. Vol. 1 (pp. 4-16). Cape Town: AMESA.

Vithal, R. & Jansen, J. (1997). *Designing your first research proposal.* Cape Town: Juta & Company Ltd.

Wahyuni, D. (2012). The research design maze: Understanding paradigms, cases, methods and methodologies. *Journal of Applied Management Accounting Research 10*(1), 69-80.

Ward, J. (2010). *Teacher knowledge of fractions: An assessment*. Unpublished doctoral dissertation, University of Otago, Dunedin.

Watanabe, T. & Huntley, M.A. (1998). Connecting mathematics and science in undergraduate teacher education programs: Faculty voices from the Maryland collaborative for teacher preparation. *School Science and Mathematics*, *98*(1), 19-25.

Wu, H. (2011). The mis-education of mathematics teachers. *Notices of the AMS*, *58*(3), 372-384.

Yang, S.H. (2009). Using blogs to enhance critical reflection and community of practice. *Educational Technology & Society*, *12*(2), 11-21.

Yara, P.O. (2009). Students' attitude towards mathematics and academic achievement in some selected secondary schools in Southwestern Nigeria. *European Journal of Scientific Research*, *36*(3), 336-341.

Yiannis, M. (1997). Understanding assessment in the classroom: Phases of the assessment process – the assessment episode. *Assessment in Education: Principles, Policy & Practice, 4*(3), 1-10.

Yin, R. (2009). *Case Study Research: Design Methods.* (4th ed.). London: Sage Publishers.

Young, E. & Zientek, L. (2011). Fraction operations: An examination of prospective teachers' errors, confidence and bias. *Investigations in Mathematics Learning*, *4*(1), 1-24.

Young-Loveridge, J., Taylor, M., Hàwera, N. & Sharma, S. (2006). Year 7–8 students' solution strategies for a task involving addition of unlike fractions. In *Findings from*

the New Zealand Numeracy Development Projects, pp. 67-86. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.564.3727&rep=rep1&type=pdf.

Yun, J.O. & Flores, A. (2008). Jelly Beans. *Mathematics Teaching in the Middle School, 14*(4), 203-207.

Zabel, L. (2014). *Understanding volunteerism in the Kananaskis region: A case study of staff and volunteers*. A dissertation submitted in partial fulfilment of the requirements for the degree of Masters of Arts, Communication and Culture, unpublished, University of Calgary, Alberta.

Zhang, M.-L., Liu, J.-H. & Wang, X.-T. (1982). The development of cognition of part-whole relationship concerning fractions in children 5-10 years old. *Psychological Sciences, 4*, 35–43.

Zulu, Z. (2013). African origin of mathematical teaching and learning. Annual International SASE Conference (pp. 19-39). Mahikeng: SASE.

1. Annexure A

P O Box 90076
0zwatini
3242
26 May 2015

The Principal
Qanduqandu Primary School
P. O. Box 197
Ozwatini
3242

Dear Sir/ Madam

REQUEST FOR PERMISSION TO CONDUCT STUDY IN YOUR SCHOOL

My name is Cynthia Nonhlanhla Chamane. I am a student at the University of KwaZulu-Natal, Edgewood campus, South Africa. I am interested in learning about teachers' experiences of teaching grade 6 fractions in Ndwedwe-Ubhaqa Circuit. I have chosen the school for convenience in generating data and I anticipate the following participants to form a sample for this study: three teachers who are teaching fractions grade 6, because the focus of the study is on the teaching.

I will ensure minimal use of school time, about thirty minutes for the interviews during and after school because I do not want to disturb the school functionality. I will also ask for permission to utilize a tape recorder when interviewing participants.

- Names of the teachers and of the school will not be mentioned or linked to any of the data generated.
- In this way pseudonyms for all the participants and of the school will be used, and will under no circumstances be revealed without your permission.
- For the purpose of data generation, the discussions will be tape-recorded, but at all times the identity of the school and the respondents will be protected.
- Data will be stored in a safe place at the university and after five years it will then be disposed of.
- Participation is voluntary; if at any time during the course of the research they will wish to withdraw themselves from the research, they will be free to do so, without any negative consequences.

The study will benefit the school in several ways: The school will have an opportunity to discuss the teachers' experiences of teaching grade 6 fractions identified once the study is finished. Findings will be disseminated to the school and the full participation of the respondents will contribute to social transformation.

Thank you for considering my request.

I can be contacted at:
Email: cynthia.chamane@gmail.com
Cell: 0723567287
Yours sincerely
C N Chamane (Miss)

My supervisor is Makhosazana Shoba who is located at the School of Education, Edgewood campus of the University of KwaZulu-Natal (Edgewood Campus)
Email Address: shobam@ukzn.ac.za
Telephone number: 031 260 3688

Discipline Co-ordinator: Dr LR Maharajh
Curriculum Studies, School of Education,
Edgewood College, University of KwaZulu- Natal
Email: maharajhlr@ukzn.ac.za
Tel. number: (031) 260 2470
Cell. number: 0822022524

You may also contact the Research Office through:
Ms Phumelele Ximba
HSSREC Research Office,
Tel. 031 260 3587, Email: ximbap@ukzn.ac.za

DECLARATION

I…… (Full names of principal) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent my school to participating in the research project. I understand that I am at liberty to withdraw teachers of my school from the project at any time, should I so desire.

SIGNATURE OF PRINCIPAL DATE

……. ……..

2. Annexure B

P O Box 90076
Ozwatini
3242
26 May 2015

Dear Participant

INFORMED CONSENT LETTER FOR PARTICIPANT

My name is Cynthia Nonhlanhla Chamane. I am a student at the University of KwaZulu-Natal, Edgewood campus, South Africa. I am interested in learning about teacher's experiences of teaching grade 6 fractions in Ndwedwe- Ubhaqa Circuit. I am studying cases from Qanduqandu School. Your school is one of my case study. To gather the information, I am interested in asking you some questions.

Please note that:

- Your confidentiality is guaranteed as your inputs will not be attributed to you in person, but reported only as a population member opinion.
- The interview may last for about 1 hour and may be split depending on your preference.
- Any information given by you cannot be used against you, and the collected data will be used for purposes of this research only.
  There will be no limit on any benefit that the participants may receive as part of their participation in this research project;
- Data will be stored in secure storage and destroyed after 5 years.
- You have a choice to participate, not participate or stop participating in the research. You will not be penalized for taking such an action.
- The participants are free to withdraw from the research at any time without any negative or undesirable consequences to themselves;
- Real names of the participants will not be used, but symbols such as A, B, C or X, Y, Z … will be used to represent participants' names;
- The research aims at knowing the attitudes of Grade 7 learners towards learning intended mathematics curriculum.
- Your involvement is purely for academic purposes only, and there are no financial benefits involved.
- If you are willing to be interviewed, please indicate (by ticking as applicable) whether or not you are willing to allow the interview to be recorded by the following equipment:

	Willing	Not willing
Audio equipment		
Photographic equipment		
Video equipment		

I can be contacted at:
Email: Cynthia.chamane@gmail.com
Cell: +27723567287 or +27711249465
Yours sincerely
CN Chamane (Miss)

My supervisor is Ms Makhosazana Shoba who is located at the School of Education, Edgewood campus of the University of KwaZulu-Natal.
Contact details: email: shobam@ukzn.ac.za Phone number: +27312603688.

Discipline Co-ordinator is Dr. LR Maharajh,
Curriculum Studies, School of Education,
Edgewood College, University of KwaZulu-Natal
(Tel) 0312602470 (Cell) 0822022524, Email: maharajhlr@ukzn.ac.za

You may also contact the Research Office through:
Ms Phumelele Ximba
HSSREC Research Office,
Tel. 031 260 3587, Email: ximbap@ukzn.ac.za

Thank you for your contribution to this research.

DECLARATION

I…… (Full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project.

I understand that I am at liberty to withdraw from the project at any time, should I so desire.

SIGNATURE OF PARTICIPANT **DATE**

…… **……**

3. Annexure C

education

Department:
Education
PROVINCE OF KWAZULU-NATAL

KWAZULU-NATAL DEPARTMENT OF EDUCATION POSTAL: Private Bag X 9137, Pietermaritzburg, 3200, KwaZulu-Natal, Republic of South Africa PHYSICAL: 247 Burger Street, Anton Lembede House, Pietermaritzburg, 3201. Tel. 033 392 1004 EMAIL ADDRESS: kehologile.connie@kzndoe.gov.za / Nomangisi.Ngubane@kzndoe.gov.za CALL CENTRE: 0860 596 363; Fax: 033 392 1203 WEBSITE: WWW.kzneducation.gov.za

Enquiries: Nomangisi Ngubane Tel: 033 392 1004 Ref.:2/4/8/545

Ms CN Chamane
PO Box 90076
OZWATINI
3242

Dear Ms Chamane

PERMISSION TO CONDUCT RESEARCH IN THE KZN DoE INSTITUTIONS

Your application to conduct research entitled: **"EXPLORING TEACHERS' EXPERIENCES OF TEACHING GRADE 6 FRACTIONS IN NDWEDWE - UBHAQA CIRCUIT",** in the KwaZulu-Natal Department of Education Institutions has been approved. The conditions of the approval are as follows:

1. The researcher will make all the arrangements concerning the research and interviews.
2. The researcher must ensure that Educator and learning programmes are not interrupted.
3. Interviews are not conducted during the time of writing examinations in schools.
4. Learners, Educators, Schools and Institutions are not identifiable in any way from the results of the research.
5. A copy of this letter is submitted to District Managers, Principals and Heads of Institutions where the
intended research and interviews are to be conducted.
6. The period of investigation is limited to the period from 15 September 2015 to 31 September 2016.
7. Your research and interviews will be limited to the schools you have proposed and approved by the Head of Department. Please note that Principals, Educators, Departmental Officials and Learners are under no obligation to participate or assist you in your investigation.
8. Should you wish to extend the period of your survey at the school(s), please contact Miss Connie Kehologile at the contact numbers below.

9. Upon completion of the research, a brief summary of the findings, recommendations or a full report / dissertation / thesis must be submitted to the research office of the Department. Please address it to The Office of the HOD, Private Bag X9137, Pietermaritzburg, 3200.
10. Please note that your research and interviews will be limited to schools and institutions in KwaZulu- Natal Department of Education.

Ubhaqa Circuit

_____

Nkosinathi S.P. Sishi, PhD
Head of Department: Education
Date: 17 September 2015

4. Annexure D

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

21 December 2015

Ms Cynthia N Chamane 200400207
School of Education
Edgewood Campus

Dear Ms Chamane

Protocol reference number: HSS/0729/015M
Project title: Exploring teachers' experiences of teaching grade 6 fractions in Ndwedwe-Ubhaqa Circuit

Full Approval – Expedited Application

In response to your application received 12 June 2015, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted **FULL APPROVAL.**

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

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Dr Shenuka Singh (Chair)
Humanities & Social Scinces Research Ethics Committee

/pm

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Cc Academic Leader Research: Prof P Morojele
Cc School Administrator: Ms T Khumalo

Humanities & Social Sciences Research Ethics Committee
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5. Annexure E: Reflective Activity

Participant's name :

Qualifications **:**

Number of teaching experience in Mathematics:

Questions

1. Rationale

(Why are you teaching fractions in the CAPS?)

_____

_____

2. Aims, objectives and learning outcomes

(Towards which goals are you teaching in the CAPS?)

_____

_____

3. Content

(What content are you teaching in fractions in the CAPS?)

_____

_____

4. Teaching activities

(Which activities are you using to teach fractions in the CAPS?)

_____

_____

5. Teacher role

(How do you facilitate fractions in the CAPS?)

_____

_____

6. Materials and resources

(With what are you teaching fractions in the CAPS?)

_____

_____

7. Grouping (Accessibility)

(How do you group your learners when teaching fractions in the CAPS?)

_____

_____

8. Location

(Where and when are you teaching fractions in the CAPS?)

_____

_____

9. Assessment

(How do you assess learners in fractions?)

_____

_____

6. Annexure F: Semi-structured interview

1. Rationale

(Why are you teaching fractions in the CAPS?)

2. Aims, objectives and learning outcomes

(Towards which goals are you teaching in the CAPS?)

3. Content

(What content are you teaching in fractions in the CAPS?)

4. Teaching activities

(Which activities are you using to teach fractions in the CAPS?)

5. Teacher role

(How do you facilitate fractions in the CAPS?)

6. Materials and resources

(With what are you teaching fractions in the CAPS?)

7. Grouping (Accessibility)

(How do you group your learners when teaching fractions in the CAPS?)

8. Location

(Where and when are you teaching fractions in the CAPS?)

9. Assessment

(How do you assess learners in fractions in the CAPS?)

7. Annexure G: Focus group interview

1. Rationale

(Why are you teaching fractions in the CAPS?)

2. Aims, objectives and learning outcomes

(Towards which goals are you teaching in the CAPS?)

3. Content

(What content are you teaching in fractions in the CAPS?)

4. Teaching activities

(Which activities are you using to teach fractions in the CAPS?)

5. Teacher role

(How do you facilitate fractions in the CAPS?)

6. Materials and resources

(With what are you teaching fractions in the CAPS?)

7. Grouping (Accessibility)

(How do you group your learners when teaching fractions in the CAPS?)

8. Location

(Where and when are you teaching fractions in the CAPS?)

9. Assessment

(How do you assess learners in fractions in the CAPS?)