TEACHING NUMBER OPERATIONS AND NUMBER RELATIONSHIPS IN A GRADE 7 CLASSROOM: A SELF-STUDY

BY

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DECLARATION-PLAGIARISM

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DR LUNGILE REJOICE MASINGA

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ABSTRACT

My self-study research focused on the teaching of numbers, operations, and relationships in a grade seven class. This study aimed to improve my teaching practice by exploring new and innovative strategies for effective teaching and learning of numbers, operations, and relationships. I was concerned with the systematic pattern of underperforming learners in this content area: numbers, operations, and relationships. I was also worried by my unintentional role in continuing with this pattern. Adopting a Realistic Mathematics Education (RME) theoretical perspective of teaching and learning helped me connect the classroom and the real world where the context has to resonate with learners' lived knowledge level. The first question that guided my research was: *What can I learn from my personal history about teaching and learning of number operations and number relationships?* This question helped me reflect on my personal educational journey and my engagement with mathematics, commencing with primary school, then high school followed by college and my first teaching experiences where I interacted with the curriculum for the first time. I identified three significant learnings from my lived experiences that influenced my teaching of numbers, operations, and relationships: i) learning to be a present teacher ii) learning through mental calculations and computations iii) learning to teach and learn mathematics using games. My second research question was: *How can I improve my teaching and learning of number operations and number relationships?* To respond to this question, I worked with my grade seven class as research participants on different lessons that I designed for this study. The learners' engagement with the classroom activities and reflections from their reflective journals helped me to understand how they perceived the teaching and learning of numbers, operations, and relationships. Throughout this self-study research journey, I worked closely with a colleague who was also a master's student, as my critical friend. I used various data sources to generate data for this self-study namely my personal reflective journal, learners' journals, photographs, memory drawings, collage, Curriculum Assessment and Policy Statement document (CAPS) and lesson plans. My engagement with this self-study journey brought about four key learnings concerning the teaching and learning of numbers, operations, and relationships: a) Aligning myself with other mathematic teachers through committees and cluster meetings b) Reimagining my enactment of the mathematics curriculum policy c) Seeing learner voice and participation as an asset in teaching and learning d): Knowledge of learners – teacher's instruction tailored to meet each learner's needs. I also learned that mathematics cannot not be taught in isolation but should be connected to learners' daily experiences.

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LIST OF ACRONYMS

OBE	Outcome Based Education
CAPS	Curriculum and Assessment Policy Statements
NCS	National Curriculum Statements
RNCS	Revised National Curriculum Statement
DBE	Department of Basic Education
ANA	Annual National Assessments
FET	Further Education and Training
COLTS	Culture of Learning, Teaching and Service
RME	Realistic Mathematics Education
MEd	Masters of Education

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CHAPTER ONE

EMBARKING ON MY JOURNEY TO SELF IMPROVEMENT

Introduction

I am a classroom-based educator who has been teaching mathematics to grade seven learners for twelve years. I have been exposed to all the curriculum changes that South Africa has undergone since the democratic era namely: Outcome-Based Education (OBE), National Curriculum Statement (NCS), Revised National Curriculum Statement (RCNS) and Curriculum and Assessment Policy Statements (CAPS). During this period, I have observed learners struggling with basic mathematics concepts as well as facing difficulties trying to recall concepts of number operations and relationships learned in the Foundation Phase (grades 1 - 3) and the Intermediate Phase (grades 4 - 6). It is quite worrying and discouraging to observe many learners regarding mathematics as a challenging subject, thus resulting in poor performance, and those who show an interest in learning mathematics but do not get the support from their parents because the parents are incapable of supporting them academically.

My aim with this study was to explore and find different teaching strategies to teach numbers, operations, and relationships in a grade seven class and, at the same time, improve and develop my teaching practice. My aim was to enhance and develop learners' calculation techniques**,** number conceptualisation as well as the advancement of number vocabulary of grade seven learners.

Focus and purpose of the study

The focus of this self-study was to improve my practice as a grade seven mathematics teacher by finding innovative strategies for teaching number operations and number relationships. My aim was to help grade seven learners develop critical mathematical skills like number vocabulary, number concepts, calculations and application skills. Grade seven is the beginning of a new phase, which is the Senior Phase (grades 7 - 9). One of the general aims of the South African Education Curriculum is to provide primary school learners with access to higher education (Department of Basic Education (DBE), 2011). However, based on what I have observed over the years, as a grade seven educator, the majority of the learners enter this grade not yet fully grasping the basic number concepts they learned in the previous grades. At the beginning of every academic year, according to the CAPS document, teachers are required to revise work done from previous grades (DBE, 2011). It is through this revision exercise, I observed that most learners in grade seven, do not have the background knowledge of numbers, operations, and relationships.

This observation was validated, by the results of the Annual National Assessments (ANA) report, which indicated that learners, who enrolled for ANA tests in 2013 and 2014 in mathematics and languages, were underperforming and did not meet the required expectations of the curriculum (DBE, 2014). The Annual National Assessments (ANA) are standardised national assessments for languages and mathematics in the senior phase (grades 7 - 9), intermediate phase (grades 4 – 6) and in literacy and numeracy for the foundation phase (grades 1 – 3). The question papers and marking memoranda (exemplars) are supplied by the national Department of Basic Education and the schools manage the conduct of the tests as well as the marking and internal moderation (DBE, 2011). It was concluded that one of the reasons for this was that learners had not yet mastered the fundamental algebraic skills (DBE, 2011). Although the conclusions were made over eight years ago, they remain relevant as in my view, there has not been any observable change in the learners' performance.

According to the CAPS document, number operations and number relationships consolidate the work done in the intermediate phase. This is aimed at producing competent and efficient learners in performing calculations, particularly with integers and rational numbers (DBE, 2011). However, from my experience as a practicing teacher in this phase, I have observed that most learners who reach this level, are still underperforming regarding fundamental mathematics skills such as mental calculations, problem-solving involving common fractions and mixed numbers that includes grouping, sharing and finding fractions. Most learners moving from primary school (Intermediate Phase) to high School (Senior Phase), still lack the necessary skills. According to the DBE (2017), the number of learners in South Africa in 2017 who obtained a 40% and above pass mark in mathematics in the matriculation examinations was 45.5% which leaves 55,5% who obtained less than 40%. These statistics prove that most learners struggle with mathematics in high school. This pattern continues until learners reach the Further Education and Training phase (FET) phase (grades 10-12), where most learners end up not choosing mathematics as their subject preference, which limits their career choices. As Graven (2017) emphasises that paying attention to numeracy teaching is better in the lower grades instead of waiting for grades 10-12, when most learners already have an aversion to mathematics because of repeated failure.

Over and above learner's performance, I also wanted to look at myself in practice since the study is a self-study and put myself as a mathematics educator in a problematic area with the issues that

learners are experiencing in teaching and learning numbers operations and relationships. I needed to interrogate my practice in teaching numbers, operations, and relationships to see what I might be doing in class that could add to some of the issues that lead to learner's problems in this area of mathematics. Schuck (2002) asserts that self-study of education entails examining one's practice in order to improve that practice. I also needed to place myself as one of the crucial elements in class to look after. This strategy would help identify how I contribute to learner's problems and what I can do to improve some of the things that I might be bringing in class that hinder the teaching and learning of numbers operations and relationships.

My duty as a teacher is to implement the curriculum effectively and to maintain a balance between the enacted and the achieved curriculum. However, there are challenges and barriers for teachers and learners that hinder effective teaching and learning in mathematics. According to Graven (2017), these challenges include, but are not limited to, "basic infrastructure, lack of teacher content knowledge, and incoherent presentation of concepts" (p. 13). Hence, the reason I embarked on this self- study, was to explore practical approaches to teaching number operations and relationships that I can use to improve my teaching and the development of mathematical proficiency. Jeremy, Swaford and Findell (2001) describe mathematical proficiency using five crucial components that are essential in learning mathematics successfully, namely conceptual understanding, procedural fluency, strategic competence, adaptive reasoning and productive disposition.

Background information and rationale

I am a black female, post level one senior phase educator, teaching mathematics in a South African public primary school. Most learners at my school come from underprivileged backgrounds where most parents are unemployed. The issue of the HIV/AIDS pandemic is still a significant challenge in the community. As a result, the majority of learners are on antiretroviral treatment for HIV. This problem dramatically affects teaching and learning as it increases the level of absenteeism because learners often miss classes to collect medication or to go for routine check-ups at the clinics. Graven (2017) regards absenteeism as one of the factors that have contributed to poor mathematical performance in South Africa. As teachers, we make sure that the learners receive excellent support from the school. We have a committee called OVC's that stands for "orphans and vulnerable children." This committee ensures that the learners are in the right place socially and emotionally to learn, by providing counselling and finding sponsors for school necessities such

as school uniforms. Most parents are unemployed and they lack an academic background, which makes it difficult for them to support their children with homework, projects or assignments. In such cases, a teacher has to play a dual role. During contact time at school, teaching and learning takes place and after normal school hours, we help them with homework. Some of the learners lack the motivation to learn because they do not have someone to look up to at home or in the community. So, as teachers, we motivate them to learn so they will have a purpose in life.

I have been teaching grade seven for the past 12 years, and this experience has afforded me the opportunity to see mathematics undergoing various pedagogical changes. In South Africa, as well as all around the world, the problem of underperforming learners in mathematics is not new, especially at schools for black learners. Bansilal (2012 p. 1) asserts that "the ANA exam results revealed that the performance of learners was much weaker in the higher grades than in the lower grades with 78% of grade one learners obtaining 50% or higher in the test while the corresponding percentage for grade six was 12%." These findings indicate that grades seven, eight, and nine learners are still experiencing problems with primary school mathematics skills.

Kunene (2011) identified numerous intervention strategies that the DBE has embarked on to elevate and improve the standard of education in South African secondary schools, especially in mathematics and languages such as the Culture of Learning, Teaching and Service (COLTS), aimed at reforming the curriculum in South Africa from the apartheid era. However, I argue that in 2018 as a teacher in practice, I have not seen an observable intervention happening in schools. I assert that six years from what Kunene (2011) noted these interventions, there are still no observable implementations in the years of my practice. It can be noted as well in the (ANA report, 2014), where the same problematic issues are still highlighted as still existing.

In the CAPS document for mathematics Senior Phase, within the five main content areas, the section on numbers, operations and relationships is the first one that suggests that the development of number senses is very crucial in the classroom as well as outside the classroom (DOE, 2011). Graven (2017) emphasised that when learners demonstrate at an early age that they are competent in mathematics, this is usually an indicator that they will excel in mathematics as they develop. In my opinion, equipping learners with the number senses at an early stage will help them to meet and cope with the demands of everyday living. The CAPS policy document for mathematics Senior Phase (DBE, 2011), also specifies certain skills for the learner to improve on fundamental mathematics skills by stating that "the learner should develop number vocabulary, number concepts, calculation and application skills" (p.8).

Research questions

The study is balanced and guided by the following research questions:

Question 1

What can I learn from my personal history about teaching and learning of number operations and number relationships?

To respond to this question, I reflected on how my lived professional experiences contributed to how I teach numbers operations and relationships, and what influences do I bring to my practice? My aim in asking this question was to learn from these experiences and improve my teaching. I used a personal reflective journal to record my reflections, to record the progress of my newly researched methods as well as my grade seven learners' reactions after I had implemented new teaching methods. In addition, I wrote about the areas where I had made improvement and I highlighted my strengths.

I used a collage to activate a dialogue inside me about my journey as an educator, especially as a mathematics educator. The collage helped me to recall, make links with, reflect, and connect events from my educational life history that influenced my teaching. I also used various arts- based data generation methods for example old classroom portraits to give a visual representation of the classroom situation.

Question 2

How can I improve my practice of teaching and learning of number operations and number relationships?

To respond to this question, I explored different strategies to improve my teaching practice. I used lesson plans with new, researched strategies. I used the researcher journal to improve and enhance teaching and learning where I recorded my progress, my reflections and the challenges I encountered during the study. I also used learner journals to measure learners' progress and achievements and how learners have perceived the teaching and learning in order to determine their learning needs.

Key concepts and theoretical perspectives

In this study, I adopted a Realistic Mathematics Education (RME) theoretical perspective to understand the key concepts that frame this study, that is, *teacher learning* and *enacted curriculum.* Realistic Mathematics Education is a mathematics domain-specific instruction theory developed

in the Netherlands by Van Den Heuvel-Panhuizen (2003) where realistic situations are given a vital role in the learning environment. The theory served as a springboard for the development of mathematical concepts, techniques, and methods, as well as a context in which students can later apply their mathematical knowledge Van Den Heuvel-Panhuizen (2003). According to Peters (2016), mathematics problems derive from real-life situations, imaginary worlds or the formal world of mathematics. For this to happen, teaching and learning must be connected to reality, and it must have relevance to learners' experiences and society at large. The aim is to teach learners to think mathematically. This framework has helped me in my study, in understanding that teaching and learning are more effective if a realistic approach is adopted where contextual problems are relevant to learners' everyday lives.

Using RME, I was able to plan my teaching methods as I explored innovative and realistic ways of teaching number operations and number relationships to my learners. To do this, I used manipulatives that are associated with learners' daily life experiences. According to Furner & Worrell (2017), using manipulatives in class can assist the learner to think, remember, and communicate about the mathematics taught in class.

The planning of my lessons for this study was influenced and guided by these six RME principles which are interrelated:

i. Activity principle
ii. Reality principle
iii. Level principle
iv. Intertwinement principle
v. Interactivity principle
vi. Guidance principle

(Van den Heuvel-Panhuizen, 2003, p. 10)

Van den Heuvel-Panhuizen (2003) explains further that these principles can also work in isolation, depending on the focus of the phenomenon.

The first principle being the "*Activity principle*," speaks to how learners must should not be treated as empty vessels, waiting to be filled with ready-made information as championed by Campbell and Campbell (2009), who stipulate that what learners bring into the classroom has a huge impact on how and what they learn. In my lessons, I had to make sure that the learners played an active role in their learning as they produced new information using their informal knowledge (Furner & Worrell, 2017). Knowing what the learners knew before the lesson, helped me to identify the new

knowledge they acquired during the lesson. For example, to introduce fractions to learners, I had to create group discussions to share what learners understand through fractions, justice, equality, and share (elaborated in chapter four).

The second principle, the "*Reality principle*" emphasises the importance of learners using their ability, understanding and resources in solving real-life problems. It also stresses that education should start with cases that are meaningful to learners as supported by Van den Heuvel-Panhuizen, 2000, p. 41) who state that "if children learn mathematics in an isolated fashion, divorced from their experiences, they will forget very quickly, and the children will not be able to apply it." When planning my lessons, I made sure that learners' pre-existing knowledge did not clash with the new content, so that the new knowledge will not become distorted in the learners' mind. For example, when I was consolidating the topic of adding and subtracting fractions, instead of completing a worksheet, learners baked cakes (see Chapter 4) to learn how to use fractions practically in the real world. In groups, they had to follow instructions in putting all the ingredients together, such as one and a three-quarter cup of milk (1¾), half a cup of sugar (½) and so forth.

The third principle, the "*Level principle"* highlights different levels that the learner has to go through to learn and understand mathematics effectively. These levels are the ability to invent simple related solutions, the creation of various levels of short cuts (techniques) and schematisations to acquire insight on how strategies and concepts are related. For example, I found from the internet a (you-tube) technique called the butterfly method for adding, subtracting, multiplying, and comparing fractions which learners found easier to use when calculating their fractions (elaborated on chapter four).

The fourth principle, the "*Intertwinement principle"* deals with the integration of the different sections of mathematics such as numbers, geometry, measurements, and data handling. Each topic is not treated in isolation but taught in relation to each other. In this work, this principle was applied in my lessons. For example, when I taught my fractions lesson in which students had to bake cakes in class, I integrated common fractions and measurements.

The "*Interactivity principle"* stresses the importance of learning in social contexts such as groups, class discussions where learners can learn and share ideas and strategies involving working with fellow learners. This principle is supported by Jupri, Drijvers and Van Den Heuvel-Panhuizen (2014, p. 39) who accentuates that "interaction evokes reflection, which enables students to reach

a higher level of understanding." I arranged the classroom into small groups of six to eight learners for most activities, give learners a sense of shared purpose, to boost their morale and motivation.

The last principle, the "*Guidance principle"* implies that educators should play a proactive role in pupils' learning–they should guide pupils' learning. For effective mathematics learning, the teacher must provide students with a learning atmosphere that is conducive to learning (Van den Heuvel-Panhuizen, 2000). To apply this principle with the help of the learners, we decorated and transformed the classroom into a conducive learning environment. Where visual aids, motivation charts are displayed on the classroom walls to serve as references when doing class activities (elaborated on chapter four).

Concept A: Teacher Learning

Kelly (2006) explains teacher learning as the method by which inexperienced teachers strive towards achieving competence. It draws a distinction between teacher knowledge and the identity of teacher. Furthermore, Putman & Borko (2000) assert that teacher learning is discovering new teaching strategies to assist learners in developing a thorough understanding of the subject. Hence, in this self-study my practice was at the core as I sort for innovating ways to teach my subject.

Schuck (2002) posits that self-study strengthens private practice and leads to reform of teacher education practice. Engaging in this study by looking at myself, there are learnings that emerged from this study that informed my future teaching. These learnings are visible in the lesson plans in chapter four where I explored new innovative strategies of teaching numbers, operations, and relationships to my grade seven class guided by the RME. Bertram (2011) claims that teachers learn by acquiring knowledge and skills as individuals and expanding their expertise in communities of practice. As a teacher in practice, I am expected by the DBE to regularly update my knowledge base to improve my practice and meet new teaching demands. In order to meet these new teaching demands in today's society which is very diverse and complex, a teacher needs to be a continuous learner. It is for these reasons that Safi (2009) suggests that primary school teachers should have an excellent foundational understanding and proper training to successfully teach mathematics. Hence, the reason I embarked on this study as a primary school teacher, was to develop myself to meet the academic needs of my learners.

Concept B: Enacted Curriculum

Van den Akker, Fasoglio and Mulder (2008) separates the enacted curriculum into two parts, the perceived and the operational. The perceived curriculum involves how teachers interpret the

curriculum, the decisions they make and the strategies they use. This meaning speaks to the process where I was engaging with the curriculum to determine the content I needed to teach and the suggested strategies by the curriculum. As I was looking at the self in practice, the curriculum became the centre of the teaching and learning, which assisted me with the creation of my planning, lesson plans, and classroom activities. The operational refers to the practice of teaching and learning as well as the experiences of the learners. I used a RME to frame my lessons guided by the curriculum as I was looking for a more realist method of teaching numbers, operations and relationships. As Cal & Thompson (2014) argues that enacted curriculum involves teachers' decisions in the curriculum implementation, in which teachers and learners interact, construct, and make meaning of the curriculum and educational experience within a given context. I based this self-study on my learning as a teacher. I believed that the RME theory worked well with the CAPS policy document because it shares the same aims that are to ensure that children obtain and apply knowledge and skills in ways that are meaningful to their own lives. Therefore, I used both the RME theoretical framework and this concept of the enacted curriculum to guide the methods of my study. With RME, students are allowed to reinvent mathematics by organising or mathematising either real-world situations or mathematical relationships and processes that have meanings for them (Cobb, Zhao & Visnovska, 2008). Engaging in this self-study research has allowed me to look deeply at and understand the CAPS policy document because as teachers, we play an essential part in implementing the curriculum (Paudi, 2006).

Concept C: Prescribed Curriculum Document (CAPS)

In South Africa, the prescribed curriculum document is the Curriculum and Assessment Policy Statements (CAPS). It is a single, comprehensive and concise policy document that has replaced the Subject and Learning Area Statements, the Learning Program Guidelines and the Subject Assessment Guidelines for all subjects are included in the National Curriculum Statements Grades R-12" (DBE, 2011, p. 4). The CAPS document explains mathematics as a "language that uses symbols and notations to describe numerical, geometric and graphical relationships" (DBE, 2011, p. 8). Mathematics in grade seven covers five content areas but I chose numbers, operations and relationships as the focus of this study. This CAPS document with content knowledge and pedagogical content knowledge for teaching number operations and number relationships in a grade 7 classroom greatly influenced writing this Self-Study. It also assisted in avoiding using common knowledge in the study, which could have resulted in misconceptions being passed on to the learners. Engaging in this self-study has helped me in understanding these concepts within the CAPS document and finding different methods to teach these sections in class (chapter 4).

Methodological approach

The methodological approach adopted in this study was self-study, where I aimed to reflect on my practice from my personal lived experiences in order to develop my practice. An in-depth methodology discussion is elaborated on, in chapter two. Loughran (2004) explain self-study as research that it is self-initiated and centred, aimed at change, interactive and involves qualitative methods. As Samaras (2011) emphasise that Self-study focuses on the researcher's personal and professional experiences, I used my personal and professional experiences to question my own practice to develop my understanding of teaching and learning of numbers, operations and relationships among grade seven learners.

Laboskey (2004) argues that self-study is all about learning from experience, integrated into teachers' development of new perceptions for themselves and those they teach, which in this study are my grade seven learners. My motive for this self-study was to improve and develop my practice as a teacher and to reflect on its meaning to myself. As Laughran et al (2007) stipulate that research on teaching practice, holds an invaluable promise to build new understandings and to produce new teaching and learning awareness. In chapter three, I narrated how I engaged with my past experiences to trigger memories of my personal and educational journey to determine how it influenced my professional journey to improve my current and future teaching and learning. Lassonde, Galman and Kosnik (2009) affirms that personal history self-study is where teachers explore and begin to identify whom they are as teachers for self-knowing, forming, and reforming a professional identity.

Conclusion and overview of the thesis

This chapter discussed the focus, background, and rationale of my study, concentrating on why I engaged in this study. I elaborated on the importance of inculcating different teaching strategies to teach numbers, operations, and relationships. I also looked at what the Department of Education says about learners' failure to meet the required expectations in primary school before being promoted to the Senior and FET phases. I then clarified my two research questions that guided my study as well as how I responded to them in this study. Finally, I briefly discussed the methodological approach that I have used, which is a self-study, and why it was suitable for my research study.

In chapter two, I described the research methodology used in this research, which is self-study. I then explained the location of the study that is at the school where I teach. I described where the school is located and the type of school it is. I then described my research participants namely my grade seven learners by explaining their socio-economic background. I also introduced my critical friend and the input she made to my study. I elaborated on the data sources I used to generate my data that was my reflective journal, learner's journals, lesson plans, memory drawings and photographs. Finally, I discussed how I tried to establish trustworthiness for my study and the limitations I encountered during the study and what I did to overcome them.

In chapter three, I responded to my first research question: *What can I learn from my personal history about teaching and learning number operations and number relationships?* I narrated my lived experiences that was my personal and professional educational journey of my engagement with mathematics. I used illustrations such as photographs and memory drawings to trigger old and forgotten memories. I then created a collage and presented it to my critical friend and supervisor. I discussed my learnings from my lived experiences and how this influenced my teaching of numbers, operations, and relationships to my grade seven class.

In chapter four, I responded to my second research question: *What can I learn from my personal history about teaching and learning number operations and number relationships?* I discussed the content, planning and preparation of my lessons to the 54 grade seven learners who were my participants. I demonstrated how I analysed the data collected from the lessons and the themes that emerged from the data analysis. Emerging from these themes were the critical learnings which I had to take into consideration when teaching numbers, operations, and relationships.

In chapter five, the final chapter, I reflected on my learnings while on this self-study journey. These were holistic learnings, methodological learnings, and theological learnings. I concluded this study by revealing how the knowledge and learnings gained from this self-study research would contribute and assist me in my future teaching of numbers, operations, and relationships.

CHAPTER TWO THE RESEARCH PROCESS

Introduction

Through this self-study research, I intended to develop my teaching practice concerning teaching numbers, operations and relationships to my grade seven class. In the previous chapter, I discussed the focus and background of this study by giving information about myself as a researcher and a participant in the study. I explained why I wanted to embark on this journey, a self-study, and what I aimed to achieve with this research study. I explained why I asked my research questions and how I responded to them. I also elaborated on the central theoretical perspective that I used to frame my study that was the Realistic Mathematics Education (RME). Finally, I briefly introduced my methodological approach of self-study and why it was appropriate for the study. I discussed how I generated my data and the data sources I chose and why they were suitable for my study.

In this chapter, I discuss my methodological approach, which is a self-study, its appropriateness, and how it helped me respond to my research questions. I then discuss how I generated my data and the data sources I chose, and why they were suitable for this research study. Further to that, I explain the ethical considerations on the procedures I had to follow to get ethical clearance from the Department of Education and the university. I also pointed out how I handled trustworthiness, where I highlighted the issues of validity and the use of multiple data sources. Lastly, I elaborate on the challenges I encountered while working on this research project and how I overcame them.

Research methodology

The study draws on the self-study research methodology, as I intended to examine and improve my teaching of numbers, operations, and relationships to grade seven learners. I wanted to respond to the problem of learners' difficulties in mastering basic mathematical concepts. I came up with new ideas and approaches to make my teaching and learning more understandable and realistic to learners and to me. Lassonde, Galman and Kosnik (2009) assert that self-study brings a significant personal reference in that it involves a study of the self and by the self. Hence, I undertook my introspective journey for 'self-improvement' LaBoskey (2004) as a mathematics teacher who believed in lifelong learning and personal professional development (p. 840). This study allowed me to enhance my practice and contribute to its reform. Through this self-study, I was encouraged to improve my practice by improving my teaching (Samaras, 2011).

Fossey, Harvey, MacDermontt, & Davison (2002) maintains that qualitative research aims to address questions concerned with developing and understanding the meaning and experience dimensions of human lives and social worlds. A self-study research approach was appropriate for responding to my research question: *How can I improve my teaching and learning of number*

operations and number relationships? It helped introduce me to various academic works that resulted in me finding new teaching strategies, ideas, and methodologies to teach and learn as advised by Schuck (2002) who maintains "awareness of literature about the area studied is essential for the self-study of the teacher education practices to have far-reaching benefits" (p. 16).

Using personal history as a self-study method, I looked at my personal history in responding to my first research question: *What can I learn from my personal history about teaching and learning of number operations and number relationships?* In looking into my practice, I wanted to use self-study to help me find what I can learn from how I was raised and taught for better understanding because self-study allows us to reflect on our lived memories and use it for future learning. According to Samaras (2011, as cited in Kortjass 2019, p. 4), "the personal history self-study method explores how personal experiences, culture, history and learning experiences can inform one's teaching." By looking at my narrative of where I was coming from (elaborated in chapter 3), I harnessed ideas to improve my current practice.

Research Setting

This study was conducted at a primary school situated in a township[1] around the Durban area in the KwaZulu-Natal province, South Africa. The school on its own is a beautiful two-story building with walls made of red bricks and fully fenced with one security guard at the gate. It is built at the centre of a semi-informal settlement, a mixture of traditional houses (brick) and informal houses (shacks). The school is at the centre of these houses. It is a school with an enrolment of 1161 learners from grade R - grade seven with only 35 teachers and 21 classrooms. All classrooms are overcrowded with a learner-teacher ratio of 1:55. The teachers are all government-paid teachers as the school cannot afford SGB (School Governing Body) paid educators since it is a no-fee school.

The majority of the learners speak IsiZulu, but the Language of Learning and Teaching (LOLT) is English, and the learners are made aware of the importance of reading. As a result, they are motivated to apply for a library card and use the community library nearby. We do have a library at our school but it has insufficient books with no computers to encourage learners to research information for assignments and investigations that are given in class. Also, the school does not have a laboratory. The non-functioning library was converted into a classroom because of a lack of sufficient classrooms and a lack of books and computers. The school does not have any sports fields, making it challenging to conduct sport as the community ground is two kilometres away

[1] During the apartheid era in South Africa, non-white citizens were forced to live outside cities in residential areas known as townships segregated by race

from the school, and it is not easy and not safe to commute primary school learners to this ground. The majority of the learners' parents are unemployed; thus, it is a no-fee paying school, which means the government exempts parents from paying school fees for their children due to their disadvantaged background. For the same reasons that most learners are from an underprivileged background, the school also has a government feeding scheme that eases the learners' short-term hunger needs to improve their learning power. The majority of the learners have limited school resources such as school uniforms, exercise books, and learning resources. Most of the learners come from child-headed households, and some live with grandparents while others live with unemployed parents who are illiterate.

Research participants

My aim for engaging in this self-study research was in full agreement with Samaras (2011) who claimed that in self-study, importance is placed on the researcher studying his/her role within the profession. This was the reason why I also looked at myself in practice as the main participant as I taught numbers, operations, and relationships to grade seven learners. As Hamilton et al (1998, p. 137) explain, "self-study is about the learning from experience that is embedded within teachers creating new experiences for themselves and for those whom they teach." In this regard, I worked with my grade seven mathematics class, comprising 52 learners ranging from the ages of 12 to 14. There were 27 boys and 25 girls. All learner participants were black and spoke isiZulu as their home language. I needed to use my grade seven mathematics class as my participants because the self-study is not about the researcher only, but what the researcher can also do for the learners and the education system (Samaras, 2011). I chose this particular class because I was their class teacher, so it was easier for me to access them and their parents for consent. Luckily, both learners and their parents showed interest in my research study.

Critical friend

In this self-study, I engaged my critical friend at various points in my journey. She became the voice of reason to pose questions and ask me to look at things differently. According to Schuck and Russel (2005), "a critical friend acts as a sounding board, asks challenging questions, supports reframing of events, and joins in the professional learning experience" (p. 107). My critical friend became an essential factor during my writing process throughout the study and gave me helpful criticism and a different perspective of my work. During the writing of this research study, I frequently met with my critical friend and my supervisor to discuss my progress and the challenges I encountered in this study. For instance, when I had to present a collage for the first time, which

had too much negative space, my critical friend advised me to use picture symbols to represent what I want.

My critical friend and I were on the same journey, as she was also pursuing her master's degree. She is a Technology teacher at one of the high schools in the township of Umlazi in Durban, a city in the province of KwaZulu-Natal. She teaches Computer Application Technology (CAT). I chose her as my critical friend because we shared a common interest as she is also undertaking a self-study research project. She made a positive contribution to my study, as she understood how self-study worked. Her role as a critical friend extended beyond our academic relationship. As a CAT teacher, she shared useful tips on using the computer, such as saving information in the cloud where it cannot get lost because it is always accessible on any device.

During this study, my critical friend offered helpful and encouraging suggestions and alternative perceptions to improve the quality of my work (Samaras & Sell, 2013). Such moments came when I was creating my lessons, and I would present what I was planning on doing and she used to make suggestions. One example was when she said, "you could also use group charts instead of the worksheet for consolidation of work where learners can help each other in recalling learned concepts." I did use her advice and found that group charts worked much better as learners shared and presented what they had learned. Any journey travelled alone for the first time, can be scary and lonely. Hence, I am grateful that self-study research allows researchers to work with "Colleagues as critical friends to gain their perspectives, support, and reviews." (Samaras, 2011, p. 8).

Data generation

In this study, the data was generated using different research practices, namely, i) researcher journal, ii) memory drawings, iii) learner journals, iv) photographs, v) learner's activities and collage, as illustrated in table 2.1. I used a researcher journal to reflect and reconstruct important life events aiding me in my professional identity formation and making meaning of my teaching and learning (Samaras, Hicks & Berger, 2004). Using these research practices has helped me to respond to both my research questions. Table 2.1 provides an illustration of the data generation activities and the data sources I used to address my research questions.

Table 2.1

Research question	**Data generation activities**	**Data sources**
Q.1 What can I learn from my personal history about teaching and learning of number operations and number relationships?	1. I narrated my personal history and the formal and informal educational experiences	1. Researcher's Journal
	2. I wrote about my formal and informal engagement with mathematics	2. Researcher's Journal
	3. I created memory drawings and old photographs to make my memories visible	3. Memory drawings and photographs
	4. Presentation of personal and professional educational journey	4. Collage
Q.2 How can I improve my practice of teaching and learning of number operations and number relationships?	1. I recorded all the reflections and observations of the teaching and learning	1. Researcher's journal
	2. Learners reflected on how they perceived my teaching and learning	2. Learners' journals
	3. Lesson planning for lessons taught	3. (CAPS) document Lesson plans
	4. Classwork Activities	4. Photographs of class activities

According to Mayaba and Wood (2015), "appropriate data generation methods are critical to a successful research project to attain rich and relevant data (p.1). In this regard, I used various data

generation methods to strive for acquiring meaningful and detailed data. To respond to my first research question: *What can I learn from my personal history about teaching and learning of number operations and number relationships?* – I used collage, memory drawings, photographs and the researcher's journal as data sources. In responding to my second research question*: How can I improve my practice to teaching and learning number operations and number relationships?* – I used the CAPS policy document, photographs, the researcher's journal, learners' journals, lesson plans, and a collage to generate data.

Researcher journal

Ovens and Garbet (2020) explains journaling in a research study, as a "process and an artefact that helps capture the immediacy of practitioners' lives through a process of intermingling description, commentary, introspection, and analysis in ways that enable deeper reflection and transformation" (p. 3). For similar reasons, I used the reflective journal in my journey as I was responding to the first and second critical questions of this study. In her doctoral research project, Ortlipp (2008) decided to use a reflective journal to "make her feelings, happenings, ideas, and thoughts, evident, to create transparency in the study" (p. 695). In the same vein, I documented all my thoughts, experiences, plans, and conversations with my critical friend and my supervisor, reflecting on what I was experiencing and the meanings behind the experience. Journaling also allowed me opportunities for reflective thinking as I discovered and resolved challenges that emanated during my classroom practice. The researcher journal helped me revisit my previous private and professional lived experiences (see Chapter 3). As Spalding and Wilson (2002) argue, reflective thinking starts with a question, I proceeded with the act of searching for material that will resolve, clarify, or otherwise address this question.

In the same way, I used a reflective journal to respond to my second research question: *How can I improve my teaching and learning of number operations and number relationships?* After each lesson, I used a reflective journal to reflect on the teaching and learning: what went well, what did not work as planned and the reasons for that. I also reflected on what could be done to prevent the lesson from proceeding as planned. I used the reflective journal, to plan and think about what I could do differently in my teaching. I documented my reflections and experiences of my entire self-study research journey, my learner participant's journey and my observations on the planned lessons on numbers operations and relationships. Figure 2.1 is a screenshot of my journal entry.

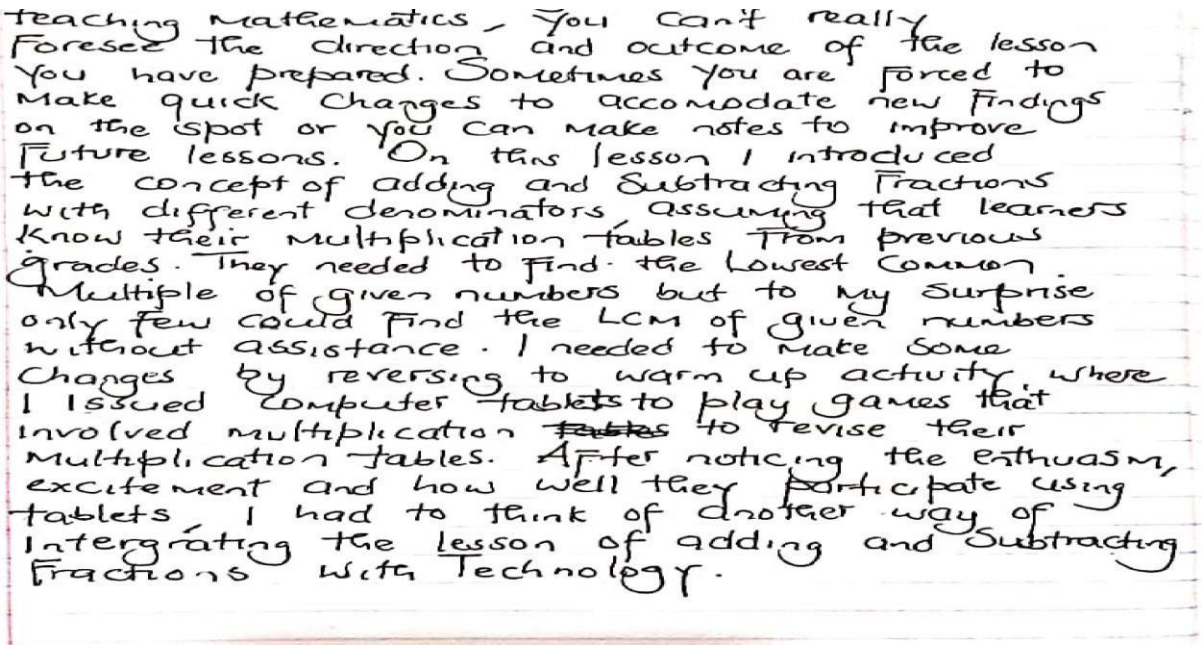

Teaching Mathematics, You can't really Foresee the direction and outcome of the lesson you have prepared. Sometimes you are forced to make quick changes to accomodate new findings on the spot or you can make notes to improve future lessons. On this lesson I introduced the concept of adding and Subtracting Fractions with different denominators, assuming that learners know their multiplication tables from previous grades. They needed to find the Lowest Common Multiple of given numbers but to My surprise only few could find the LCM of given numbers without assistance. I needed to make some changes by reversing to warm up activity, where I issued computer tablets to play games that involved multiplication ~~tables~~ to revise their Multiplication Tables. After noticing the enthusasm, excitement and how well they participate using tablets, I had to think of another way of Intergrating the lesson of adding and Subtracting Fractions with Technology.

Figure 2.1 Screenshot of my journal entry

Learners' journal

Learner's journals were documented by learners to record what they felt about what transpired in the mathematics lessons (elaborated in chapter four). I requested that they reflect on their individual experiences, how they perceive their learning, and what they felt hindered effective learning of numbers, operations, and relationships. At first, they could not understand journaling as they only recorded what was learned instead of how they perceived the lesson. I then helped them with how to start writing their reflective journals. I did this by giving them the following guiding questions: What are your feelings about the lesson? What helped you to understand? What can help you to understand more? What did you like about the lesson? What did you not like about the lesson? What new things or new vocabulary did you learn?

I explained the term "pseudonym" to them as being a fictitious name they were to create for their journals, which guarantees whatever they write in their journals would not be used traced back to them one day. They seemed happy and relieved to hear that. I collected and read learners' journals at the end of each topic to know how the learners perceived the lesson so I could improve by emphasising certain aspects of the lesson. By engaging with the learner's journals, I understood their reactions to the lessons and what they hoped to see happen in the classroom (elaborated in chapter four. Figure 2.2 is a screenshot of a learner's journal cover with a pseudonym for their name.

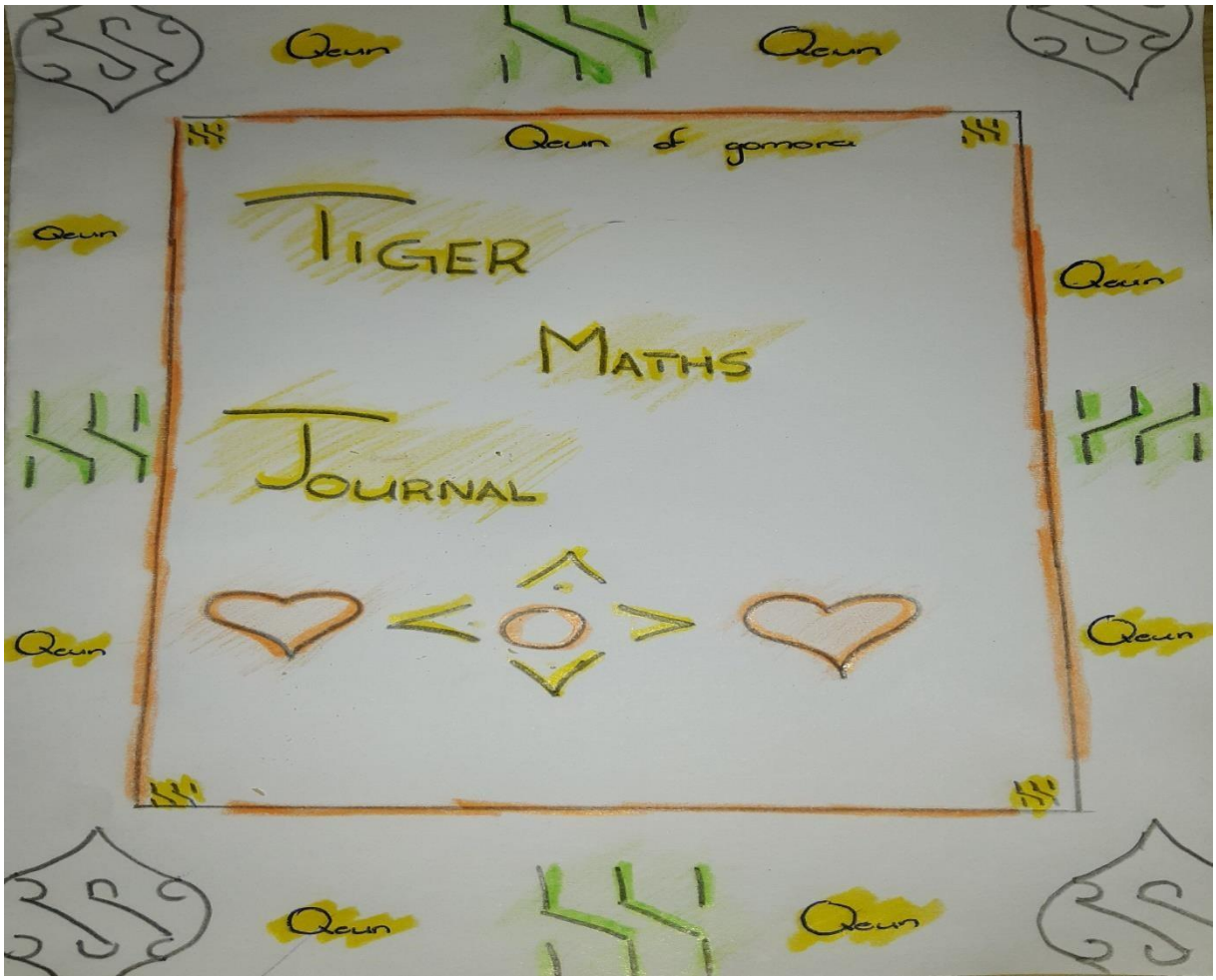


Figure 2.2 A screenshot of a learner's journal cover with a pseudonym for the name.

Lesson plan

The lesson plan is a useful instrument for the management of teaching and learning activities in a lesson. Milkova (2012) describes a lesson plan as the teacher's plan of what learners should learn or how to progress successfully throughout classroom time. Similarly, Cicek and Tok (2014) also describe a lesson plan as a detailed record of what the teacher would have liked to have done during a given lesson. To accomplish my goal while engaging with my second research question: *How can I improve my practice of teaching and learning of number operations and number relationships?* I worked with my grade seven class as participants in the study. The lessons I used for this study, I planned and taught in line with the Curriculum Assessment and Policy Statement (CAPS). I also used the Annual Teaching Plan (see figure 4.1 in chapter 4) provided by the Department of Education as a guide to planning the introductions and lesson activities for both learners and myself, the questions to be asked, the content, the aims /objective /outcomes of the lesson, the development of the lesson assessment activities and the materials as well as the resources used.

My aim for the planned lessons was to teach the familiar content of numbers, operations, and relationships using different approaches to make teaching and learning more realistic and meaningful. The techniques, approaches, and resources designed for this research study are also elaborated on in chapter four.

Curriculum Assessment Policy Statements document (CAPS)

Taba (1962) refers to the curriculum as a plan for learning. As an educator who was engaged in a study of the exploration of the self in practice, I followed and implemented the prescribed Curriculum and Assessment Policy Statement for Mathematics Grades 7-9 (CAPS) to guide my research. The Annual Teaching Plan (ATP) clarifies what to teach and when to teach it. I complied with these curriculum expectations when designing my lesson plans and I kept to the Department of Basic Education's timeframes.

Collage

Butler-Kisber and Poldma (2010) explains a collage as a method of using images or any found materials and pasting them onto a flat surface to represent an idea or depict a concept. Further to that, they describe the collage as the "visual inquiry approach of formulating ideas and expressing the connection between them to understand concepts" (p. 2). Similarly, in this self-study, I used collage to activate a dialogue inside me and my journey as a mathematics educator. The collage helped me recall past events, make links, reflect and connect events from my personal and educational life history and I showed how these past events influenced my teaching.

In this research study, I have used four collages in different chapters. For instance, in chapter three, I created a collage using images and other symbolic metaphors that formed part of my identity of my personal and professional self. This collage helped me conceptualise my lived experiences by revealing different aspects to get a deeper understanding and meaning of past events. I presented this collage to my supervisor and critical friend, who helped me connect my past educational history with the teacher I am today. They did this by asking probing questions such as "elaborate on the kind of teachers who taught you and how you felt throughout your schooling?" This was one of the questions that made me think deeply about the kind of teacher that I do not want to be. Therefore, collage helped me narrate my self-study research journey using images to identify both the indescribable and describable parts of my personal and mathematics educational journey (Hamilton & Pinnegar, 2009).

Memory Drawings

Mitchell, O'Reilly-Scanlon and Weber (2005) state that drawings can generate data such as memories, emotionally difficult information, and self-perception. In the same way, I have used memory drawings in chapter four to recall my personal and educational lived experiences. Furthermore, Mitchell, O'Reilly-Scanlon and Weber (2005) explains that "art can help us to experience feelings and thoughts that may have been repressed or forgotten" (p.37). In chapter three, when I narrated my engagement with mathematics during my primary school years, memory drawings helped me represent my experiences after I experienced a temporary memory block that hindered me from narrating my story. My critical friend's suggestion of memory drawing also helped to clear the temporary memory block I experienced. My memories became more vivid as I remembered my childhood and that I loved drawing pictures of my family. From then on, memories of my primary school years started coming back, and I drew a picture of a game we used to play called "amagenda." Amagenda was the game that made me love mathematics as it involved counting (see Chapter Three). Memory drawings in this study enabled me to express myself and represent some of my experiences that I was not able to recount verbally (Pink, Kurti & Afonso, 2004).

Photographs

I used two types of photographs in this study, old photographs from my mother's album and a memory box, to retrieve memories of my personal and educational journey. According to Winton (2016), photography "can open up new ways to tell stories, and to communicate lived experiences" (p. 432). These photographs assisted me in recalling some of my forgotten memories from primary school to tertiary education. For instance, an old photograph of myself on my first day at school (see figure 3.4 chapter three), helped me remember when and where my love for numbers started. This photograph also helped me recall how I learned mathematics and how this influenced my mathematics journey (see figure 3.4 in chapter four).

I also used photographs that I took with my cellular phone to capture specific moments and stimulate the gathering of information as I observed learners' engagement with given tasks. I took photographs of my grade seven learners while they were busy with activities during prepared lessons on teaching numbers, operations, and relationships (see chapter four). I took a photograph of my learners watching an online lesson on a projector screen. When reflecting on the lesson afterward and looking at the photograph, I realised that they were attentive in that lesson which

made me conclude that using technology in class captures learner's attention and arouses their interests.

Making meaning of my lived experiences

To make meaning of my lived experiences, I worked inductively with the data I collected to respond to my research questions. I did this by firstly collecting data through sources such as lesson plans, learner journals, researcher journal, Annual teaching plan and CAPS document. After collecting a large amount of data, I took a step back to examine the data, looking for patterns in the data to develop themes Braun & Clarke (2006).

In chapter three, I responded to my first research question: *What can I learn from my personal history about teaching and learning number operations and number relationships?* I created a collage, presented it to my supervisor and critical friend, discussed it, and received feedback from them to reflect on my journey. These reflections helped me realise that every experience we go through, whether good or bad, there are lessons to be learned. From my lived experiences and engagement with mathematics, I extracted four learnings that I believe were beneficial to my teaching practice of teaching numbers and relationships to my grade seven mathematics class. These learnings were:

i. learning to be a present teacher
ii. learning through mental calculations and computations
iii. learning to teach and learn mathematics through games

In responding to my second research question: How *can I improve my practice of teaching and learning of number operations and number relationships?* I completed the planned lessons' teaching process. I needed a tool to help me analyse and make meaning of the data collected from the lessons I conducted and my engagement with my grade seven learners. I chose the thematic six-step approach by Braun and Clarke (2006) to explain thematic analysis. They explain thematic analysis as a technique to recognise, examine, and report patterns (themes) within data (p. 79).

This data analysis led to four themes:

- Hands-on learning through manipulatives
- Bringing technology into the grade seven mathematics class
- Conducive grade seven mathematics class
- Other interesting pedagogical learnings.

These four themes that emerged from the analysis, led me to discover and identify certain aspects that I learned from conducting planned lessons and engaging with my grade seven class. I explored and developed new strategies for teaching and learning number, operations, and relationships.

My critical friend's involvement also contributed positively to the last stage of this self-study research, when I created a collage to present my discoveries and my learnings in teaching numbers, operations, and relationships to my grade seven class. Working with my critical friend and my research supervisor, helped me put things into perspective to bring unexpected insight to my learnings throughout the study (Schuck & Russel, 2005). The following learnings emerged from critique and probing questions from my critical friend and research supervisor: i) Aligning myself with other mathematics teachers through committees and cluster meetings; ii) Reimagining my enactment of the mathematics curriculum policy; iii) Seeing learner participation as an asset in teacher and teacher-learner positive relationships; iv) Knowledge of learners-teachers instruction tailored to meet each learner's needs.

Ethical considerations

To obtain permission for the study, I applied for ethical clearance from the university where I am registered for my qualification. I then wrote a letter with all the proposed study details to my school principal seeking permission to conduct this study with my grade seven learners and the consent form accompanied this letter.

To guarantee participants' confidentiality, I informed them of their rights. I also informed them that any information used in this study, will be treated with confidentiality. I explained the concept of pseudonyms to them and the reasons for using them. I then asked them to choose a pseudonym for themselves to use in their reflective journal as advised by Samaras (2011) who emphasises the importance of protecting the participants' identities by checking that their work does not include identifiable information. In the consent letters that I sent to parents, I explained that whatever content I taught in class during my study, was prescribed by the DBE in the CAPS document.

For the learner's journals and learners' tasks that I used, I wrote consent letters to parents to permit me to use the learner's work as part of my study. In the letters, I explained what the study was about and that it would not interfere or disturb the learners' schoolwork or performance. The issue of the right of refusal was mentioned to parents and with my critical friend, I asked her to sign a consent letter to allow me permission to use the suggestions and ideas from our meetings and discussions. All these consent forms were kept safely throughout the study and I also protected the school by using a pseudonym for the name of the school.

Trustworthiness

As an educator, trustworthiness plays an integral role in the teaching and learning environment. The depth and adequacy of my knowledge as a teacher is something that learners need to trust (Hamilton & Pinnegar, 2000). The Department of Basic Education (DBE) trusts that as a teacher, I will implement the curriculum effectively. To do that, I needed to be conscious of my learners' ever-changing needs. To honestly achieve that, I also needed to be developed, hence I embarked on this study of my practice (self-study).

To ensure trustworthiness I followed the advice of Feldman (2003), who gives clear guidelines on how validity can be increased in self-study by advising that we improve the validity of our self-studies by paying close attention to and making public how we construct our research representations. He proposes the following approaches to do it: "Provide a clear and detailed description of how we collect data and make explicit what counts as data in our work" (p.27). At the beginning of chapter four; I clearly showed the details. I described the process of how I collected my data and presented it. I also used multiple data sources like researcher journal, photographs, learner journals, and learner's activities what the learners did in class during the lessons to record what transpired from the lessons during the teaching and learning in class. Safi (2009) confirms Feldman (2003) guidance by stating that the researcher needs to prove that the data generated can be trusted when conducting qualitative research. The data that I collected from learner's journals was verified with information gathered from observations made during the lessons conducted and documented in the researcher's journal.

Feldman (2003) also advises "Provide evidence of the value of the changes in our ways of being teacher educators'' (p28). In chapter five, I showed what i learned from this self-study and what it has done for myself as an educator and for my practice. These values are visible through the learnings I learned from this self-study journey. In chapter five, I discuss my contribution in teaching and my plans to work collaboratively with other mathematics primary teachers to find innovative strategies for teaching mathematics.

Feldman (2003) argues that a clear and more detailed description of how the data was collected must be provided in order for a study to be considered valid. Therefore, to ensure validity in my study, I have also used the Curriculum and Assessment Policy Statement Senior Phase (Grades 79) policy document (CAPS) as one of my data sources. I also used the 2018 Annual Teaching Plan provided by the Department of Basic Education to prepare the lessons that formed part of my data.

In my reflective process, when I looked at how my lived personal history and experiences influenced my teaching of number relationships and number operations, I used a collage to map

out my engagement with mathematics from primary school, high school and tertiary level. It helped me to understand how I perceived mathematics throughout those years that had a significant influence on the person I am today. My critical friend was also another way of establishing trustworthiness and validity as she always provided critical feedback and ideas. As Samaras & Sell (2013) states, the role of the critical friend is to offer alternative perceptions to improve the quality of the research, I therefore involved my critical friend in my research process. This prevented me from being biased with regard to certain assumptions I made in my study because I gained objective feedback from my critical friend.

Research challenges

The biggest challenge that I encountered during my study was finding time for learners to write their journal entries to reflect on what they had learned in class and how they perceived my teaching. To overcome this challenge, I asked them to write their journals at home and treat them as their diaries. I had to teach them how to draft the afternoon timetable to budget their time accordingly, in order to accommodate homework, house chores and leisure activities.

The challenge of overcrowded classrooms has always been a problem in our school because the school is situated in a semi-informal settlement, 5km away from the town. People come from rural areas to look for work in this area because it is closer to town and the bus/taxi fare is cheaper. According to the South African Schools Act no. 84 of 1996, no child residing 5km from their home can be denied access or admission to the school; only the Head of Department can. For this reason, our classes are overcrowded. At the beginning of the term, I had 46 learners in my class, but then I ended up having 52 learners. As a result, some of the planned activities took a long time to be completed, because of the large number of learners.

Another challenge I experienced was adhering to the timeframes that I stipulated in my research proposal. I had assumed that by the end of March 2018, ethical clearance from both the Department of Basic Education and the university would have been granted, but unfortunately, they were both delayed. The one from the university arrived on the 4th of May 2018, and the other from the Department of Basic Education only came the following year, 2019. This ethical clearance caused a delay as I could not start with my research or collect data before permission was given, and my principal needed these clearances to grant me his approval.

Conclusion

This chapter aimed to showcase and explain how I generated my data for this study and the different data sources that I used to gather the data. I also introduced the participants and highlighted the significant role they played throughout my study. Further to that, I gave an overview of the ethical considerations I had to consider before I could begin with the study. Lastly, I explained the limitations and challenges that I encountered during the course of this study.

In the next chapter, I respond to my first research question: *What can I learn from my personal history about teaching and learning of number operations and number relationships?* I reflect on my educational journey through my reflections in my reflective journal. The aim is to reimagine things that might have influenced the teacher that I am today and identify certain influences that might help shaped and moulded my current practice. I also came to value the importance of learners' voice in teaching and learning through learner journals, where learners were given a chance to provide feedback on how they perceived the teaching and learning.

CHAPTER 3

HOW MY PERSONAL HISTORY INFLUENCED MY TEACHER IDENTITY

Introduction

In the previous chapter, I discussed the methodology of my study, which is self-study. I identified and described the methods I used to generate data for this study. I also explained the procedures I used to obtain ethical clearance and consent. I brought to light the challenges I encountered when doing this study and elaborated on the trustworthiness that establishes the validity of the study.

In this chapter, I respond to my first research question: *What can I learn from my personal history about teaching and learning of number operations and number relationships?* To achieve this, I revisited my positive and negative mathematics life stories in order to show how my childhood and adult life, both personal and professional, influenced my journey thus far. I also reflected on how my lived experiences made me the person and the teacher that I am today. I looked at the lessons learned throughout my personal history experiences and what I can take from there and use to develop my practice. To achieve this, I firstly used a collage to help activate and recall forgotten memories. I also used memory drawings and photographs to stir my memories because I learned that memory work can be used for teacher development because it assists teachers to face negative memories (Hobden, 2012).

My formal and informal lived mathematical experiences

To begin reflecting on my life history, I used a collage to trigger some memories from my personal history in order to develop and inform my practice. As indicated by Gerstenblatt (2013), the use of a collage in a qualitative research study can "provide the opportunity to include marginalised voices and encourage a range of linguistic and non-linguistic representations to articulate lived experiences" (p. 294). To help me find this voice, I first created a collage that represented different aspects of my life through images and words. After creating the collage, I then presented it at one of our critical friends-supervisor meetings, where my supervisor and my critical friend were both present. The aim was to get them to listen and assist with the narrative of my story by probing further with questions, which made me think deeply about the life and experiences that I wanted to share. One of the questions asked by my critical friend was “in your narrative, you mentioned that your sister played a big role in your upbringing while your mother was working long and odd hours, do you thing if your mother was working differently, would your life have turned out

differently, for better or for worse?" This question made me think deeply and I realised that my mother was a hard worker and she taught me to follow my dreams and be independent.

Some of the questions they asked which were meant to enrich my life history, I did not have immediate answers to. However, later, I was able to reflect on these questions as I listened to the recorded conversation and made journal entries of what I was thinking. One of the questions from my critical friend that I did not have instant answer to was "the topic of your collage is formal and informal educational journey with mathematics and you included a game. What role was played by games in both your formal and informal educational journey?" These kinds of questions were the catalysts for deep introspection and thinking. Figure 3.1 is the collage presented to my critical friend and supervisor, showing my primary to tertiary educational journey.

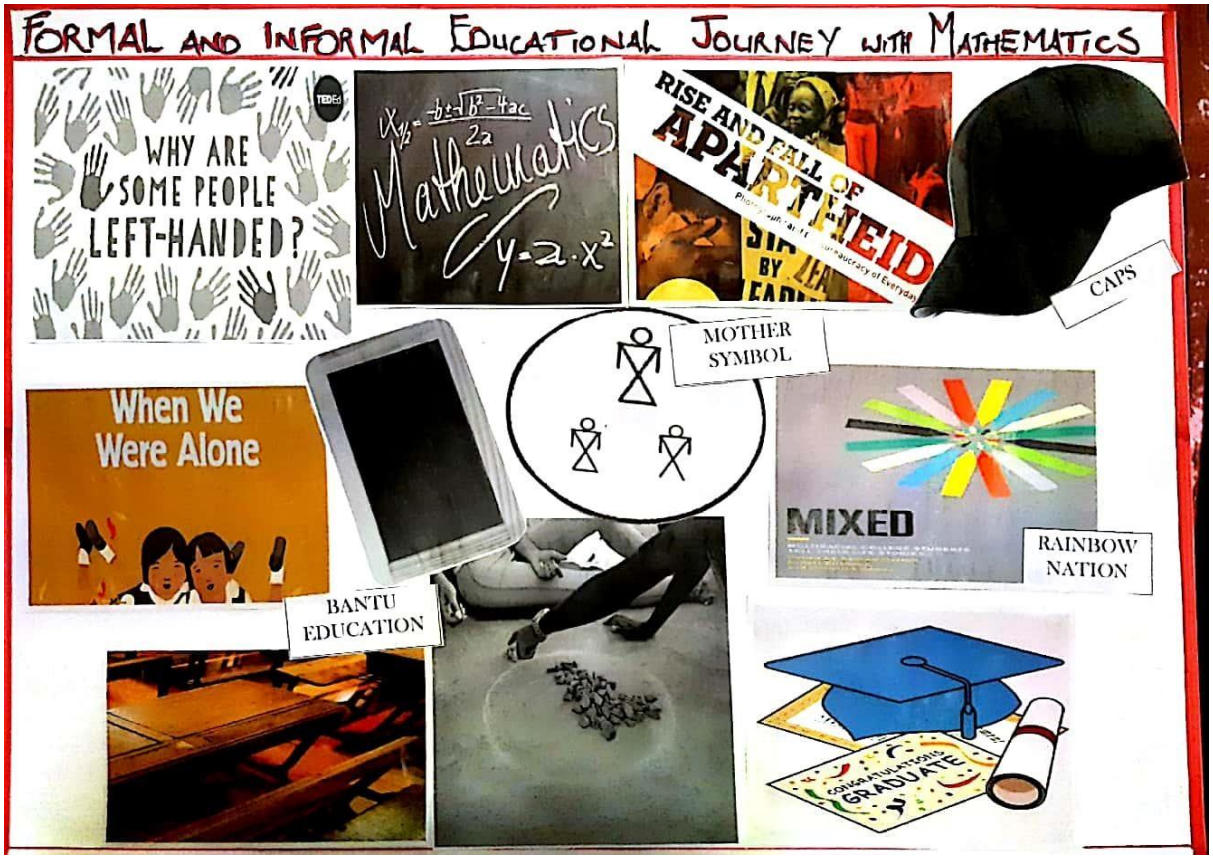


Figure 3.1 The collage presented to my critical friend and supervisor, showing my primary to tertiary educational journey.

Home life: Formal and informal engagement of mathematical experiences

On the 28th of March 1976, I was born. I was raised in a township around the Durban area in KwaZulu- Natal, South Africa. Growing up in a township, even though it was tough, due to issues of apartheid, it bestowed the morals, values, and the work ethic I have today. I was raised by a powerful, brave, hardworking woman who was a general worker at a nursing home and also a single parent to three girls. Working in a nursing home meant she had to work long hours, including Saturdays, Sundays and holidays. Most of the time, she used to leave home very early in the morning while we were still sleeping and come back at night when we were already asleep. My eldest sister was not living with us. She was living with my aunt in a rural area in KwaZulu-Natal for reasons unknown to me up to now. The only person who looked after me while my mother was at work was my other sister who played a significant role in my life.

Figure 3.2. A photograph of my mother and the sister who took care of me

As a child, both my mother and my sister made a significant impact in my informal education. My mother used to leave home for work very early and come back very late and would leave strict instructions for my sister and I to do the household chores. One of these tasks was to prepare the items for the evening meals for her to cook when she came home, as we were not allowed to use the paraffin stove (primer stove) because it was not safe. She would tell us how many potatoes to peel.

We had to cut half an onion, half a tomato and wash the rice so it would be easier for her to prepare supper when she came home late. I was still very young and could not do these chores, but I would watch and observe my sister doing them, and I would be counting everything that she was cleaning such as potatoes, green beans and other vegetables. When my mother came back from work at night, she would cook, but most of the time, we would already be asleep, and we would eat the food the following day. While waiting for our mother to come home at night, we would make up stories to tell each other when we were frightened since we had no grandmother to tell us stories. It was as if we knew that stories and storytelling are part of the history of every society and the oldest forms of communication known to humans. Figure 3.3 is one of my old-time favourite stories that my sister used to read for me.

Author: unknown	***The deaf frog (Translated)***
Iselesele elalingezwa emadlebeni	*There was a frog that had a wish to climb on the top of a well. It tried a couple of times. Every time it tried, it fell, but that did not discourage the frog.*
Kwakukhona iselesele emadlebeni, kodwa linesifiso sokufinyelela esicongweni.	*Other animals, including frogs, made a laughing stock at this frog, saying climbing is not for frogs but other animals. Even that did not make the frog stop trying; eventually, the frog finally made it to the top.*
Lalilokhu lizama kodwa lishelele libuyele emgodini, liphinde lizame. Abantu babelokhu belihleka bethi ngeke liphumelele, izinyoni kuphela ezikwazi ukuphumelela. Iselesele alizange libanake, lazama kaningana laze lagcina liphumelelile.	*When they asked what make it not to listen to those that discouraged it, it said it is because it was deaf and was only concentrating on the goal of reaching the top.*
Uma selifikile esicongweni abanye balibuza ukuzi yini eyenza ukuthi liqhubeke lizame nanoma ezinye izilwane lingalaleli lezilwane ekade ziligxeka.	
Lase lisho ukuthi lona alizwa emadlebeni, alibazwanga abebelihleka kodwa lona belibheke esicongweni kuphela lapho belifisa ukufinyelela khona	

Figure 3.3 My favourite story in IsiZulu translated into English.

All these childhood memories formed part of my informal learning, and even today, I am still inspired and motivated by some of those old stories.

Before I began school, my family had already informally shaped the path of my formal education. I started school in Sub A (grade one) at the tender age of four years, which was unusual in 1981 because I had no one to look after me at home. My mother was working, and the only available

person was my sister, who was seven years older than me and was doing standard three (grade five). Looking after her baby sister meant she had to drop out of school, which was a common thing to do at that time, just like many other children her age, who also dropped out of school to look after their siblings, especially girl children.

However, my sister decided to go back to school without my mother's knowledge. When our mother had gone to work, my sister would take me to school with her. While she was in class, I would be outside playing amagenda/diketo (throwing stones game) in the school playground by myself until the school finishes. Figure 3.4 is a re-enactment photograph of a learner playing amagenda by herself on the playground.

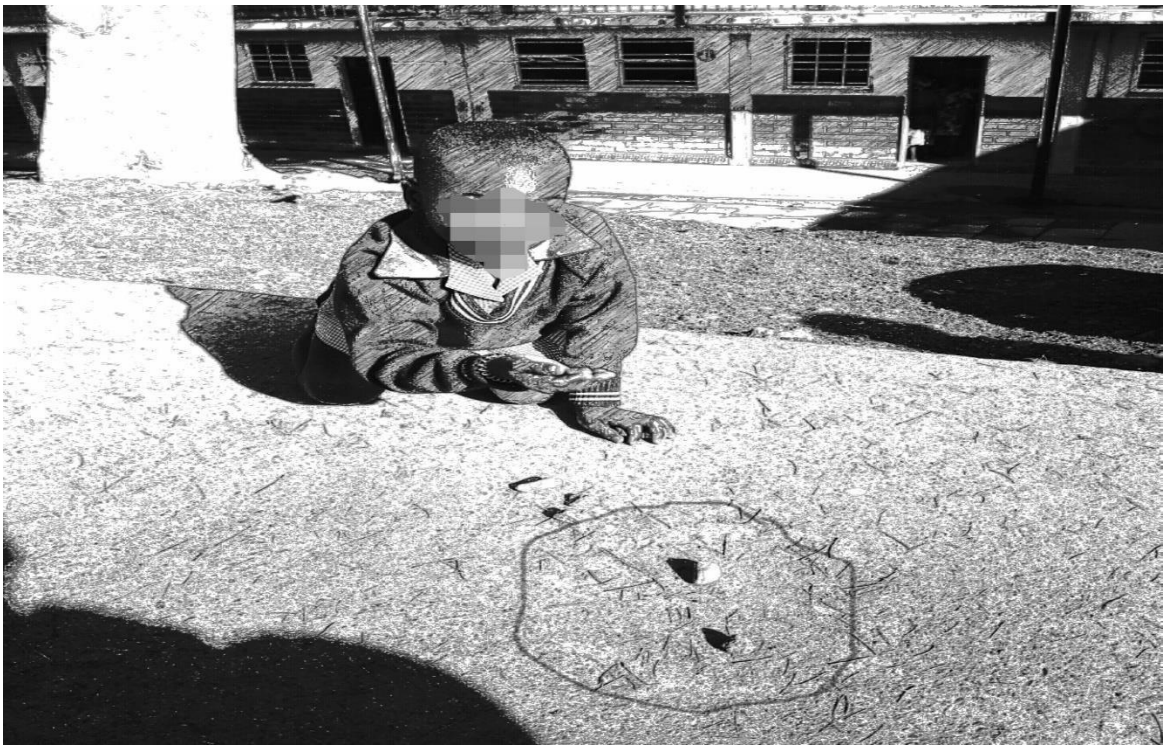


Figure 3.4 Re-enactment photograph showing a learner playing amagenda by herself on the school playground

This game was played using ten stones where a player would put the ten stones in a circle/square then would throw one big stone (ingede/ghoen) up in the air with one hand, while with the same hand try to scoop the ten stones out of the circle before catching the ghoen again. Then the player would again throw the ghoen and return nine stones to the ring and keep one. On the next step, the player throws the ghoen and scoop nine stones out of the circle before catching the ghoen again. Then the player will throw the ghoen and return nine stones to the circle and keep one. The pattern will continue until all the stones were out of the circle, and the player or the winner will pat the circle while throwing the ghoen up and catching it. The winner would be the one who managed to

successfully scoop all the stones out of the circle without fail. This game taught me a lot about counting skills and building number skills naturally and realistically.

Eventually, the teachers noticed this child who did not go to class. At first, they thought I came for food because there was a feeding scheme at school because during lunch breaks, my sister would sneak out and share her food with me, a cup of hot cocoa and a slice of bread. Figure 3.5 is a memory drawing of my sister sharing her food with me at school.

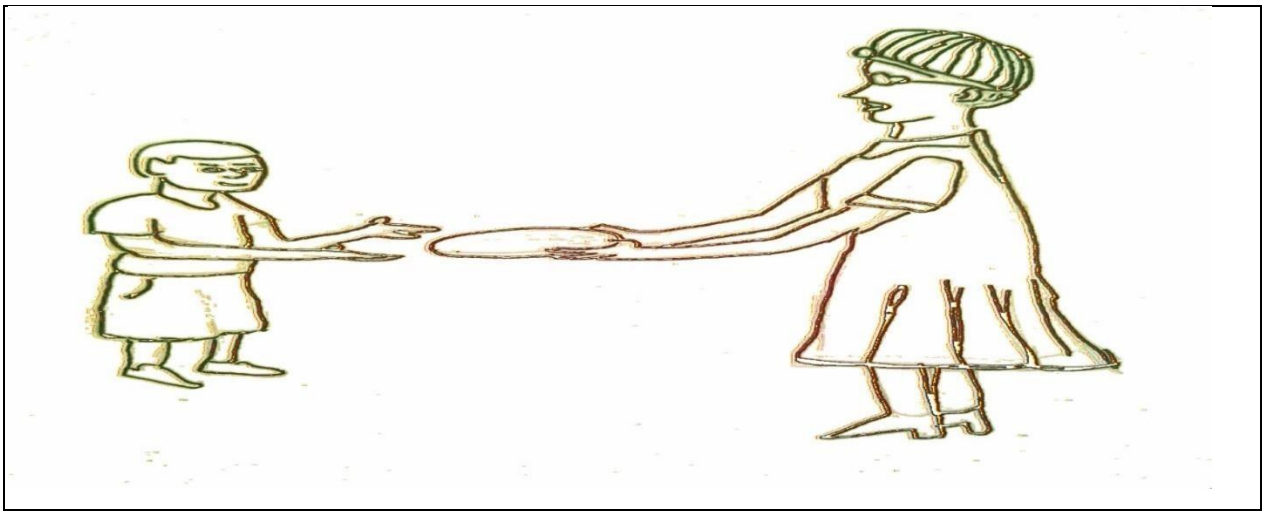


Figure 3.5: Memory drawing of my sister sharing her food with me at school

When the teachers called my sister, she explained the whole situation, that there was no one to look after her baby sister at home, and she felt coming to school was the best solution so that she would not miss school. The teachers empathised with us and advised her to call my mother to school with my birth certificate. After they had verified the story with my mother, they agreed with my mother that they will enrol me as a pre-school learner who would not be promoted to the next class the following year because I was only four years old at that time and would be turning five towards the end of the first quarter. Figure 3.6 is a photograph of me in Sub A, posing in a studio with a school uniform.

Figure 3.6. A photograph of me in Sub A, posing in a studio in a school uniform

That was how I ended up starting school at the age of four instead of seven years, which was the school entry age at the time, as stipulated by the Department of Bantu Education[2] (Nkondo, 1979).

In the mornings, my mother would wake us up as early as 3:30 am to prepare us for school before going to work. She would get us dressed and leave the house around 5am. We used to go back to sleep on top of the bed and wait for the alarm clock to ring at 6 am, then we would eat our already prepared breakfast and go to school. Even though I did not have the full concept of time at that stage, but I knew when it was time to leave for school. My mother had taught me by showing me that when the long needle of the clock was at twelve and the short one was at seven, it would be time to leave for school.

Raised by a single mother who was a domestic worker, working long hours, was challenging as it meant we were mostly by ourselves at home. My mother spent very little quality time with us. Sometimes, I would come home very excited, sad or sick, and wanted to share those experiences with her but only to find that, I would fall asleep while waiting for her. I had to rely on my sister to help me recite the rhymes and poems that we learned at school. In the mornings, there was not enough time to talk to my mother as there were so many things that she needed to take care of before she left. I ended up asking my sister to convey messages on my behalf in case I fell asleep

[2] In 1958 the Department of Bantu Education was established in South Africa, governed by the **Bantu Education Act that was** responsible for the education of Black South African (called Bantu by the country's apartheid government) children.

early, and she would wait for my mother, then I would find the response to whatever I was asking in the morning waiting for me.

Despite the difficulties that we went through, when I look back, I see that a hard-working woman would do everything in her power to provide for her children. She taught us independence at a very early age, even though at that time, we did not see it that way. We used to think that she was not motherly as most of our friends would come home to their mothers and find freshly prepared food. Most of the time, my mother would come back tired from work but would still make time for her family. We never went to school on empty stomachs, without lunch or with creased clothes. My mother never complained and I believe that she was the reason I am this person today, hardworking and independent.

My primary school experiences

The name of my school was Icola Primary school situated in a township around Durban, KwaZulu Natal. Even though my school was one of the disadvantaged schools with limited resources, it had a proper building structure (red bricks) that consisted of 12 classrooms, including the school hall, which was a combination of two classrooms. The school had clean running water from the taps, flushing toilets but no electricity and fencing. The food was prepared in the kitchen using firewood for the majority of the learners because they were coming from underprivileged families. On the menu, we used to have samp and beans, cocoa, soup and a slice of bread. I can still remember waiting patiently for the recess bell to ring so that we could pray and go to the kitchen to receive our food.

The enrolment was very high with three to four learners sharing one desk, which was very difficult, especially for me because I was left-handed, and my direction of doing things and writing was not the same as my desk mates. When writing, I preferred writing on the left side of the desk and any other person sitting on my left would interfere with my writing, which resulted in fights because other learners could not understand why I always wanted to sit on the left. Figure 3.7 is re-enactment memory photograph of a left-handed learner struggling to write, sharing a desk with right-handed learners.

Figure 3.7 Re-enactment memory photograph of a left-handed learner struggling to write, sharing a desk with right-handed learners

I also never understood the real reason for their reaction until I embarked on the journey of this selfstudy. This experience made me aware of the challenges that left-handed learners experience. As Misigo (2015) points out that the way left-handed learners sit causes both mechanical and social problems because writing takes place from left to right, the left-handed hooked style of hand posture, creates conflict with their right-handed colleagues. Until I engaged in this study, I had not thought of how it affected my desk mates when I would fight to sit on the left-hand side.

At primary school Sub-A (grade one) and Sub B (grade two), we learned only two subjects: isiZulu and Izibalo Zekhanda (mental calculations), also taught in our vernacular language isiZulu. We used a slate to write on, which meant we could not keep records of what we wrote in the previous subject when it was time for the next subject. Because we had to erase the writing on the slate. The teachers depended on drilling and rote learning methods to teach under these difficult circumstances with limited resources. I can still remember how we recited the multiplication tables (timetables) as we used to call them, in the mornings and immediately after breaks as if it was a song. At that time, it had no meaning for me, but it did help me when I was in higher grades as I quickly related to number senses. In mental calculations, we never had written homework but only verbal instructions to go home and learn by heart whatever the teacher told us. My sister would help me by allowing me to recite the sums to her repeatedly and correct me where needed, and my mother would do the same on weekends when she was off from work.

In so many ways, throughout my primary school years, I enjoyed mathematics even though I could not conceptualise what was taught but I was intrigued by the way they taught it. It was as if we were on the playgrounds, as the teacher used to instruct us to find sticks or small stones to use as counters. We would use these counters to help us count, add, or subtract numbers, and we would then write on our slates just as Peters (2016) claimed that learners can initially work out mathematical context problems using mathematical tools or models they have at their disposal.

After school, I liked to play games that involved numbers which most of the children my age were not fond of because they could not count correctly, and I could. That is why I used to play with older kids who were my neighbours, usually on the school's dusty playgrounds. We played amagenda, which was my favourite game and ingqathu (skipping and jumping rope), which both involved counting forwards and backward while playing. Ingqathu was a game commonly played by girls with a rope. We used to create our rope using tall grass and plait it by twisting it to a length of about 3metres. I enjoyed the counting rhythms in class. Even when we were playing skipping (ingqathu) during breaks and after school, we used similar rhythms. Ingqathu is a skipping game played by three people. Two players hold the skipping rope on each end, while the third player skips in a variety of ways, chanting and singing while counting, like jumping three times, then on the fourth count, you would touch the ground while keeping the rhythm and if the rope hits you, you lose. I do believe playing these games like amagenda and ingqathu helped me a lot with my basic mathematics, especially number recognition because it involved much counting because, by the end of the year in Sub A, I could easily count from 1 to 100.

When I reflect on my primary school years, I see that the reason why I performed well in mathematics was because I enjoyed it, and it was realistic. I felt at ease during mathematics lessons as I could easily relate the concepts and contexts with my ordinary and everyday world. I realised that I was left-handed and my early school days were challenging as I found it extremely difficult to write some of the vowels like "a" and "e" because we were instructed to write it in a particular order or pattern. The teacher used to say "ndingilizana kwesokudla dwi" which meant draw a circle, then on the right of the circle, you draw a small line. I used to draw my circle then put the line on the left of the circle, then my "a" would be a "p." It took me quite a while to overcome this problem, and as for the formation of words, it was worse, as my hand would also tire very quickly as compared to my other right-handed classmates. This experience made me dislike all the writing lessons as I would struggle to complete given tasks. My drawings were also indecipherable and

mathematics was the only subject that I could excel in, because it did not involve lots of writing, and I became fond of it.

My high school experiences

In preparation for high school, I applied to two high schools that were highly regarded in the township, due to their excellent matriculation examination results. They had an unbeatable record of 100% pass rate as compared to other neighbouring schools. Only one school accepted my application, but on condition that I passed an aptitude test, which they advised, was to determine our career paths at an early stage in order to place us in relevant classes such as Commerce, History, Science or Technical Drawing. I went for the aptitude test, and I wrote two tests, one for mathematics and the other for English. The mathematics test was manageable, and it was in the form of multi-choice questions. Even though I cannot remember the questions, but I still remember the strict instructions given to me, which was to use the spare paper given to us to calculate before choosing the correct answer. The second test was an English paper. It was based on general knowledge questions and was challenging. We had to write a short essay on "why do you think you are the best student to be enrolled at this school?" I was thrilled when I received the letter in the post stating that I passed the aptitude test and was accepted at the school and that became one of my biggest highlights for the summer of 1987.

When the schools re-opened, they enrolled me in the mathematics and accounting class. Although we never received the scores for the aptitude test, I was confident that the reason I was placed in the mathematics and accounting class, was because of my excellent performance in mathematics.

My first day was quite intimidating as we were standing in the assembly area. The principal of the school was addressing us in English. At primary school, teachers used to code-switch, where teachers would move between English and isiZulu when they teach or speak to us. I trembled and felt that I was on a different planet where people were speaking a different language. I told myself that if others were coming from the same school as I was, and were able to understand, meant I could also get used to English as a medium of communication and the language of learning and Teaching (LOLT). The principal also made it clear that any kind of misbehaviour was not tolerated, and the manner in which he said it, made me shiver. I swore to myself that I would never get in his bad books. The discipline in the school was rigorous and we had to conform to every rule, otherwise, the cane (which was a type of stick) would sort you out. Fortunately, the feeling did not last long as my class teacher was a lovely lady who taught us accounting, and I was excited because it looked similar to mathematics. The fact that accounting also uses numbers made me

like it more, and I assumed it would be as easy for me, just as mathematics. I was curious to learn more about it, but the, terminology, and different types of accounting exercise books used to make entries were quite confusing. As we were learning how to record financial accounts by debiting and crediting the money to relevant journals, we felt like real business people.

I still remember the first day of my mathematics lesson, where a tall, dark male teacher with a beard came in and introduced himself, and then handed out test papers. We were confused and in disbelief, as we could not understand the purpose of writing a test before learning. The test paper consisted mostly of the work we did in standard five (grade seven), which was the previous year. The next day, he came back with our marked test papers, and I managed to score 17 out of 20 marks, and those who scored less than ten received punishment for it. He told us the reason he did that was that he wanted to set the record straight from the beginning, that poor performance was not allowed in his class. Except for fear of failure, which forced me to pass mathematics from standard six to standard eight (grade eight to ten), I cannot recall the teaching methods he used, but I think the reason might be because I was so scared of him, and he never expressed personal interest in his learners. Unfortunately, I never had the opportunity to be taught by a different teacher because there was a system in the school where one teacher would take a group of learners from standard six up to standard ten, then come back and take a new group after 5 years.

Sports activities were introduced, and it was compulsory to affiliate to at least one. I joined the netball team, but unfortunately, I did not last long. The coach was so mean and rough I could not cope. I then tried my luck with the school choir and again I could not survive, I had to be at school as early as 6:30am for the morning practice and to leave school late after afternoon practice. I had to take a bus to and from school, and after school hours, the bus fare was more, and that forced me to leave the choir. My mother could not afford to pay extra money for my transport, not to mention the fact that I was not even good at singing.

I then felt hurt that I did not have a sense of belonging since I was not a member of any sporting group because I was not sport orientated. For these reasons, I enrolled in the girl-guide movement. Figure 3.8 is a photograph of me as a girl guide.

Figure 3.8 Photograph of me as a girl guide.

As soon as I made my girl guide pledge called a Guide Promise, everything changed for the better. A Guide Promise referred to an oath that was made at a special ceremony to enrol and welcome new members. The promise was universal to all guides since the movement was universal, "*I promise that I will do my best to do my duty to God and my country. To protect other people at all times and to keep the Guide law."* In the girl guides, I soon experienced a sense of belonging at school and made new friends in the process because we shared the same goals.

The first three years of high school were exciting. The Girl Guides taught me to face challenges and to work as a team towards a common goal. For three years, I managed to earn at least four badges after the successful completion of a specific challenge. For example, when the team had gone camping and managed to complete the given tasks and challenges, then you earned a badge. This engagement helped to improve my self-esteem, and I could see myself as a future leader. This confidence also translated into how I felt about school and the work I had to do.

Looking back at the time I spent being a member of the Girl Guides. I could now see how it was linked to the love of mathematics I had at that time. Mathematics was all about challenges and finding different ways of solving problems where creative thinking was involved. On the team, we were trained that every problem has a solution, our duty was to find that solution, and it was the same with mathematics. One of the activities I can still remember that we played at night when

on camping, to practice logical thinking skills, was the game Sudoku. Sudoku was a grid like a puzzle with blank squares so that each row, each column, and each of the three x three grids contains one instance of each of the numbers, one through to nine. Figure 3.9 is an example of the Sudoku game.

3	1					5		8
					1		9	
7		4	3		5			2
			9					7
			2				3	4
4								
5					3			
1			4	8			6	
	6		7		9		8	

Figure 3.9 An example of the Sudoku game

Therefore, for two years in high school, mathematics was still my favourite subject, and my performance was excellent even though I was not an A student, but I always managed to score myself C's and sometimes B's. When I was in standard eight (grade ten), there were political uprisings in the township, and then everything changed. The school I went to belonged to a certain political group, which was not favoured in the township. Going to school was no longer safe. There was a time when wearing of school uniforms in the township schools was regarded as a sign of oppression to the black students. Most learners in the township stopped wearing uniforms, and they wore black and white, black skirts for girls and white shirts, and the boys wore black trousers and white shirts.

Unfortunately, at my school, the principal was against the idea, so if you were not in full school uniform, it was either you were denied entry to school premises, or you would receive corporal punishment. I remember one day on our way home from school, wearing the school uniform; a mob of boys from other schools attacked us, calling us traitors, and they poured some liquid acid on us to destroy our uniforms and punish us in the process. Luckily for me, the acid landed on the denim school bag that I was carrying, and it ruined it with holes, which made me wonder what

would have happened if it had touched my skin. Going to school was not safe anymore therefore, many learners dropped out of school.

Boarding school life

My mother's priority was for us to get a better education and because of these incidents, she felt sending me to a boarding school was the right thing to do. I then went to a boarding school to do standard nine and ten (grades eleven and twelve). The reception I received at my new school was incredible as I was expecting the worst. The school was opened to boarders for the first time, and it had been only a day school before. Everyone was new at the boarding house and we all had to adapt to this new environment, new rules as well as new teachers with their own teaching methods.

At this stage, I was mostly concentrated on my social life without any interference from my mother. Since we had no afternoon duties at the boarding house, we spent much time chatting, trying to get to know each other, and finding common interests with my boarder mates. Even though we had time allocated for studying in the evenings, we spent most of it writing letters to friends we left at home, which left little or no time for schoolwork.

At this stage, my social life had improved; I was enjoying my new-found freedom. I made new friends and participated in several activities such as the jazz group, the school choir and the Christian movement. When I got into standard nine (grade eleven), my academic performance dropped, especially mathematics. The exciting social life substituted my love for mathematics. Even though, I will forever treasure the memories and friends I made in my first year at boarding school, it cannot measure up to the consequences I suffered, because I was not paying full attention to my studies.

The following year, 1992 was my final year in high school. I knew I had to work twice as hard if I was to obtain my matriculation certificate. I studied hard, but I was a little too late as I could not fill the gap that I opened the previous year, especially in mathematics, as all the work we did was a continuation of standard nine work. It was only then, in standard ten (grade 12) a year later, that I took notice that the style of teaching was not working for me. It was teacher-centered, our mathematics teacher would introduce the topic by writing it on the chalkboard. After that, he would explain it by doing a few examples on the chalkboard then give us problems to write in our exercise books using the examples as a guide. The next day, we would do the corrections as a class on the chalkboard, the teacher would write while the class shouted the answers to him step- by- step. There was no time for individual attention. If you felt you were not following or you were struggling, the best way was to find someone who seemed to understand well to explain to you

after school. It was as if we were on a race of some sort, rushing for the finishing line, which was the syllabus. I even wrote a letter to my mother explaining that I was not coping, especially in mathematics, and I still remember some contents of the letter, as I recalled and recorded it in my research journal. Figure 3.10 is a memory drawing of the letter I sent to my mother.

Umthwalume High School

Private Bag X534

Umzinto

12 May 1992

Dear Mom

Thank you for the lovely shoes you sent with my sister as my birthday present. I loved them. I will be wearing them this coming Saturday at the school concert.

I write this letter to inform you that I am having difficulties with my studies, especially mathematics. I find it hard to understand most of the work, and I am afraid to talk to my teacher about it. He is always busy, and I doubt he will have time for me.

The fear of failure frustrated me because mathematics has always been my favourite subject, but I will keep trying harder.

Please send my love to my sister, tell her I miss her

Loving you

Futhi

Figure 3.10: A memory drawing of a letter from myself in boarding school to my mother

I was so surprised the following Monday when I was called to the office to collect a parcel, only to find out that my mother had bought me study guides for all the subjects to assist me with my studies. I was overjoyed even though I knew she might have borrowed the money to buy these study guides because I knew her financial position. To possess these study guides gave me the power to form a study group, and I also invited those learners who understood mathematics better to be part of our study group as they came with knowledge, and I came with resources.

Eventually, I managed to pass my standard ten (matriculation) with a D aggregate, but in mathematics, I obtained an E symbol after it was converted into a standard grade pass. Figure 3.11 is a photograph of my matriculation statement of results.

South African Certification Council

Suid-Afrikaanse Sertifiseringsraad

SENIOR CERTIFICATE
SENIOR SERTIFIKAAT

Awarded to/Toegeken aan

PRISCA NTOMBIFUTHI ZONDO

Date of Birth 1976-03-28 Geboortedatum

Subjects passed/Vakke geslaag

Zulu : First Language / Zoeloe : Eerste Taal	HG	D	50%-59%
Afrikaans : Second Language / Tweede Taal	HG	D	50%-59%
English : Second Language / Engels : Tweede Taal	HG	D	50%-59%
Biblical Studies / Bybelkunde	HG	C	60%-69%
Accounting / Rekeningkunde	HG	E	40%-49%
Business Economics / Bedryfsekonomie	HG	E	40%-49%
Mathematics / Wiskunde	SG	F *	33,3%-39%
Aggregate / Groottotaal		D	1050-1259

A result marked with * does not comply with the pass requirements for university admission.

'n Uitslag gemerk met * voldoen nie aan die slaagvereistes vir universiteitstoelating nie.

ENDORSEMENT
This candidate has complied with the minimum statutory requirements for admission to bachelor degree studies at a university in the Republic of South Africa.

ENDOSSEMENT
Hierdie kandidaat het voldoen aan die minimum statutêre vereistes vir toelating tot baccalaureusgraadstudie aan 'n universiteit in die Republiek van Suid-Afrika.

With effect from DECEMBER/DESEMBER 1992 Met ingang van

Executive Officer F. Lalit Uitvoerende Beampte

This certificate is issued without alteration or erasure of any kind. Hierdie sertifikaat word uitgereik sonder verandering of uitwissing van enige aard.

[redacted]

1358224

Figure 3.11 A photograph of my matriculation statement of results

The fact that I achieved an E symbol in mathematics on the standard grade meant I could not register for a Bachelor of Commerce degree at a university since the minimum requirement was an E symbol on the higher grade for mathematics. I was hurt because that limited my chances of pursuing my dream of becoming a chartered accountant, but I never gave up.

My college experiences

In 1994, I enrolled at a college of education for the Higher Diploma in Education (HDE). It was a college of education that was predominantly for white students but after the country was transformed from the apartheid era to the democratic era, this college was one of the institutions that embraced freedom and democracy by enrolling non-white students. It was my first time being in a multi-racial environment, not to mention being taught by a white lecturer. Everything was new. The language and the terminology were confusing. I could not tell the difference between the words "lecture" and "lecturer." The buildings were huge as compared to the schools in the township. Moving from one lecture to another, was a big hustle and chaotic. For the whole of first

term, I used to arrive late at lectures as I was trying to locate the correct lecture hall. Luckily, the lecturers were very tolerant and understanding.

It took me some time to make friends with students of other races. As soon as I entered a lecture hall, I would very quickly look for another black student to sit next to. Intense debates would occur inside the classrooms and in the corridors, not because of racial intolerance but because we could not understand each other and our backgrounds. It hurt to realise the extent of privilege the white students had while growing up and the type of education they received as compared to us black students and the unfairness of being measured with the same yardstick in terms of assessments and presentations we had to present in class. The truth of it meant that as black students, we had to work twice as hard in order to meet the college standards. At first, the college accepted me for the Secondary Teacher's Diploma to major in accounting, but once I registered, I was allowed to change to the senior phase because other senior students, advised us that studying to be a secondary school teacher was no child's play and most students did not graduate. Now, I realised that they played with our vulnerability and insecurities at that time as I was struggling to cope with my not so good matriculation results. That is why, it was so easy to be derailed. Myself and some of the new friends I had just met, changed our course of study, and enrolled for senior phase teaching.

Everything changed, the style of teaching and learning was no longer the same, which created a lot of confusion and frustrations. The medium of instruction was English. Lecturers were facilitators rather than instructors. Both the students and the lecturers were actively involved in teaching and learning. We were taught a different concept of what a teacher should be which was different from what we were used to, where an educator was a compliant civil servant. We were informed that as future teachers, we were going to be knowledge producers, and we had to take charge of our classrooms, initiate discussions, and select relevant content for the curriculum in order to empower learners. I was excited about this new method of teaching and learning, and it took me back to the period where mathematics was still my favourite subject.

On my first day of the mathematics lecture, which was not pure mathematics but mathematical literacy, the lecturer introduced the topic by having a discussion with us on what we understand by the words "myths and misconceptions", and we were asked to give examples. Some of the explanations and examples we came up with were:

> A myth is a false belief like in Zulu culture, and we believe that when a girl child is eating in a pot, it will rain on her wedding day.

A misconception is a wrong view or opinion on something based on incorrect understanding for example, contraception causes infertility

According to Jankvist and Niss (2018), "it is not enough to merely tell the students that their misconceptions are responsible for the difficulties they experience in mathematics, they must be brought to realise this themselves based on their own experiences" (p.2). After that lengthy and exciting discussion, the lecturer asked us to debate the truth of myths. She then moved on to myths in mathematics and misconceptions about certain assumptions for example:

Mathematics is for bright students only.

Men are better in mathematics than women.

You have to be born with mathematics talent in order to master it.

Once the lecturer dispelled these myths and misconceptions, most of the class was motivated to study mathematics. Even though I could not recall the exact teaching methods, we were taught that engaging the child in teaching and learning was the top priority. We were told that gone are the days where teaching was only teacher-centered, but both the teacher and learner should be actively involved in the lesson. We were introduced to different mathematics games such as bingo, where we were taught how to design a game to introduce a specific topic for the lesson or for consolidation of the lesson (see collage learning from my personal history).

The four years that I spent at the college of education, were the best years of my life. My experiences re-shaped my entire adulthood by restoring my dignity. My strength was tested, both mentally and physically, by having to adapt to an environment I never knew existed. When I came to the college of education, I came with just my name, but I left with the title of 'teacher.'

In our final year, we were informed that the education system in South Africa was going through a transformation and a new curriculum was introduced namely Curriculum 2005 which was underpinned by Outcome Based Education (OBE). This change was going to take place, and we were one of the first groups of teachers who would graduate from college minimally trained on a new curriculum as compared to practicing educators. The feeling of being a part of such a revolution was exciting, and I knew I could be a facilitator of this new pedagogy in a learner entered classroom where learners were in charge of their learning and designing their own learning materials. This feeling was liberating.

When I graduated in 1997, the DBE was no longer employing new educators because of the over-supply of practicing educators. Figures 3.12 are photographs of me with my family on my graduation day.

Figure 3.12 Photographs of me with my family on my graduation day

I could not practice my newly acquired knowledge, when I was employed as a teacher. Five years of being unemployed brought so much disappointment that when it finally happened, everything had changed. There was no eagerness to implement the new OBE system. At the school where I was employed, no one was excited about OBE. Curriculum 2005 and OBE was being phased out. The teachers at my school were talking about the new curriculum that was to replace Curriculum 2005 and OBE. The new curriculum was called the National Curriculum Statements (NCS) and was to be implemented the following year. Teachers were attending the workshops about the NCS and I happened to only attend the final workshops. Fortunately, my colleagues were kind enough to assist me in filling the gaps in my knowledge of NCS, even though it was not the same as receiving the information first hand.

My interactions with the NCS

In the short period I had implementing OBE in a township school, I encountered a few challenges. One of those challenges was the integration of learning areas where subjects were grouped into Learning Areas (LA). The lack of resources was also a barrier because my school was in a semi-informal area where most of the parents are unemployed. Learners could not afford even to bring old newspapers to class because parents did not read them because they also could not afford to buy newspapers. Even though the school had a duplicating machine, we had no means of binding

the worksheets to create booklets. Teaching in a no-fee school meant that the school had no funds to buy resources. The lack of teaching aids such as chart paper and posters on multiplication tables had a massive impact on my teaching of mathematics, and that was when I learned and understood the meaning of the word improvise.

To overcome this dilemma, the school fundraising committee of which, I was the chairperson had to step in and derive some fundraising drives to raise funds to help with some of the teaching and learning resources such as photocopying paper, scissors and glue. To fundraise, we used to ask learners n to come to school in their casual clothes instead of their uniforms and pay R1. We did this once every month end. We also had market days at least once a term where the committee used to sell food to the learners and educators.

While these fundraising activities was taking place, the DBE decided that the NCS needed to be revised and this resulted in the Revised National Curriculum Statements (RNCS) being developed. By this time, I had finally found my feet as a practicing teacher, and I also learned the difference between theory and practice. I also came to believe that experience was indeed the best teacher. With the RNCS, the different grades were grouped into phases as follows:

Grade R to Grade 3: Foundation Phase

Grade 4 to Grades 6: Intermediate Phase

Grade 7 to Grade 9: Senior Phase (SP)

Grade 10 to Grade 12: Further Education and Training Phase (FET

There was a lot of new concepts we had to learn with this new curriculum for example: outcomes and the associated assessment criteria. This new curriculum also meant more work and teachers of the same subject in a phase had to meet and plan the outcomes, assessments and content that needed to be taught. The curriculum put much emphasis on assessments. Also, as educators, we were expected to have a plan of intervention for learners who were underperforming in order for them to meet required expectations. Cluster groups were formed, which comprised of teachers in the same district, teaching the same subjects. Attending cluster meetings, and going to RNCS workshops took much time away from teaching and learning. As a result, the learners who were supposed to be benefiting from this new curriculum actually were being disadvantaged when their teachers were absent from class as they were attending the cluster meetings.

In 2011, the DBE decided the RNCS was not an effective curriculum and they developed the Curriculum Assessment Policy Statements (CAPS) as the new curriculum for all grades from grade

R to grade 12. There was a one-day workshop where all mathematics teachers in our district were inducted to the Curriculum Assessment Policy Statements (CAPS), which was to be phased in the following year, 2012. Teachers were workshopped on how to implement the CAPS policy document. The publishing companies were also invited to this workshop, and they orientated us on different teaching resources that we could use, including textbooks which included a Learner's Book and a Teacher's Guide with answers to the exercises given in the Learner's Book.

With the Curriculum and Assessment Policy Statements (Caps), I felt that I was finally in a functional space. There were many programmes put in place to lower the workload of the teacher especially with the previous administrative workload with Curriculum 2005, the NCS's and the RNCS's. We no longer had to design our learning programmes and the DBE designed an Annual Teaching Plan (ATP) that must be followed by teachers and which outlines the teaching and assessments on a day-to-day basis. With CAPS, the content to be taught is predetermined. The teacher's duty is to familiarise themselves with the content knowledge and how to teach it. As long as the teacher adhered to the given guidelines, no problems were expected. Nevertheless, there were problems. The CAPS policy document did not accommodate slow learners because a teacher cannot spend more than the allocated time on particular topic. Despite this problem, I can relate to and I feel comfortable with CAPS because it resembles the type of curriculum I was taught as a learner under the apartheid Bantu Education system where the content was prescribed and teachers were not allowed to deviate from the prescribed curriculum

As a South African mathematics teacher, I feel that being part of this curriculum journey has helped me tremendously in knowing and realising my professional teacher identity. I have come to an understanding that teaching and learning is a lifelong process. Keeping that in mind, I will always welcome any change that will develop me to be a better teacher.

My learnings from my lived experiences for teaching numbers and relationships to my grade seven mathematics class

Revisiting my personal history and my engagement with mathematics helped me to discover that there is a lesson to be learned from every experience that we go through. Similarly, with my personal history, I learned from both the negative and positive experiences I had in my journey of life, which could have influenced how I teach my learners. After sharing my personal history, I needed to gain an understanding of what it was that I was learning, which could improve my practice. To facilitate this process of learning through my lived experiences, I created a collage and used it as a tool to extract my lost and forgotten memories. Figure 3.13 is a collage representing my learnings from my personal history.

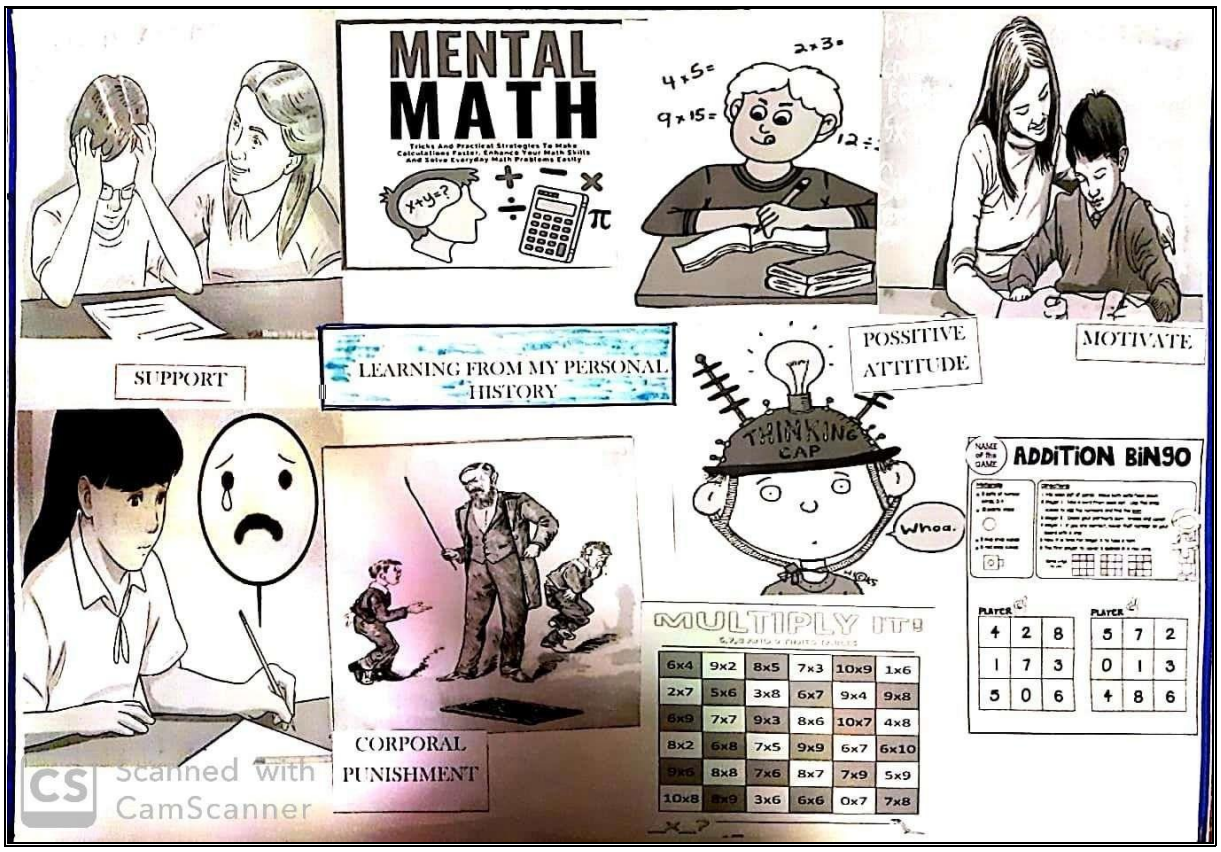


Figure 3.13 A collage representing my learnings from my personal history

Upon completing the collage, I then presented it to my supervisor and my critical friend, as I shared with them my significant learnings from my personal story. My learnings were: Learning to be a present teacher, learning through mental calculations and computations, and learning to teach mathematics through games.

Learning to be a present teacher

The lack of memories of my first-year mathematics experiences in high school, made me realise the importance of the teacher in the classroom. As shared in chapter three, I was amazed that I had very little to say about mathematics in the first few years of my high school career. The only thing I could remember is a tall, dark teacher with the beard who was my mathematics teacher for three years from standard six to standard eight (grade 8 to grade ten). Other than the intimidating tall figure, I could not recall anything. I felt that there was a wall that prevented me from remembering that chapter of my life. I could not reflect on how mathematics was introduced and taught in high school. I could not remember what we were taught and also the methods of teaching and learning used to implement the mathematics curriculum at that time.

It got me to think that my teachers did not make much of an impact on me so much so that I could recall my memories of them and their teaching. This got me reflecting deeply that I must be the kind of teacher for my learners so that they will have fond memories of the impact I made in their lives as a mathematics teacher. I came to the conclusion that I am an important learning resource for the learners therefore I must make a great impact on how learning will be experienced in my class. This understanding meant I should always provide learners with opportunities to see me as that positive resource for them to learn from me as their mathematics teacher. I learned that my presence as a teacher and the role I am playing should be clear to the learners. If the learners do not understand what they should be receiving from the teacher, it is easy for them to forget their work. It is essential to remember that as a resource, I should be aware of what my learners need to make teaching and learning useful and meaningful. Hobden (2012) contends that teachers as curriculum implementors need to go beyond the call of duty to create positive attitudes towards the teaching and learning of mathematics. Further to this, he also argues that teachers who had travelled their memories on their engagement with mathematics, tend to have more insight on how to deal sensitively with learners who experience problems with mathematics.

This experience taught me that having a teacher whom I cannot even remember how/what he taught and the role he played in my mathematics journey has made me realise that it is the kind of learning experience that I do not want to create for my learners in my mathematics classroom. I want to be a present and supportive teacher so that my learners would see me and connect with me and view me being critical to their process of their learning. They should remember me as one of the teachers who played a significant role in their curriculum journey. I should also make working with numbers as part of their fond memories. Figure 3.14 is an image representing a supportive teacher.

Figure 3.14 A cartoon image from representing a supportive teacher

Engaging in this self-study has taught me that when planning my lessons, I need to prioritise my role in the classroom and take note of what needs to happen, from the way I teach to how I assist the learners with what is needed to be learned. I want to inspire my learners to look at numbers, operations and relationships not just as a topic in mathematics, but also as a resource or tool to help them to become lifelong problem solvers and critical thinkers.

Learning through mental calculations and computations

Looking back at my engagement with mathematics in primary and high school using the Realistic Mathematics Theoretical Framework lens, it helped me realise the importance of understanding number sense in order to master mental calculations and computations. It is my view that one of the reasons we fail to implement effectively, the mental calculations and computation strategies in our teaching and learning, is because of how we were taught as children. The teaching strategy in mathematics relied on one method, which was rote learning of basic facts. Therefore, we lack indepth knowledge of computation strategies. According to Rogers (2009), for students to be adequately prepared for the mathematical demands of life, school, and work, they must be assisted to be proficient users of mental computation. Figure 3.15 is an image showing different techniques to make mental calculations easier.

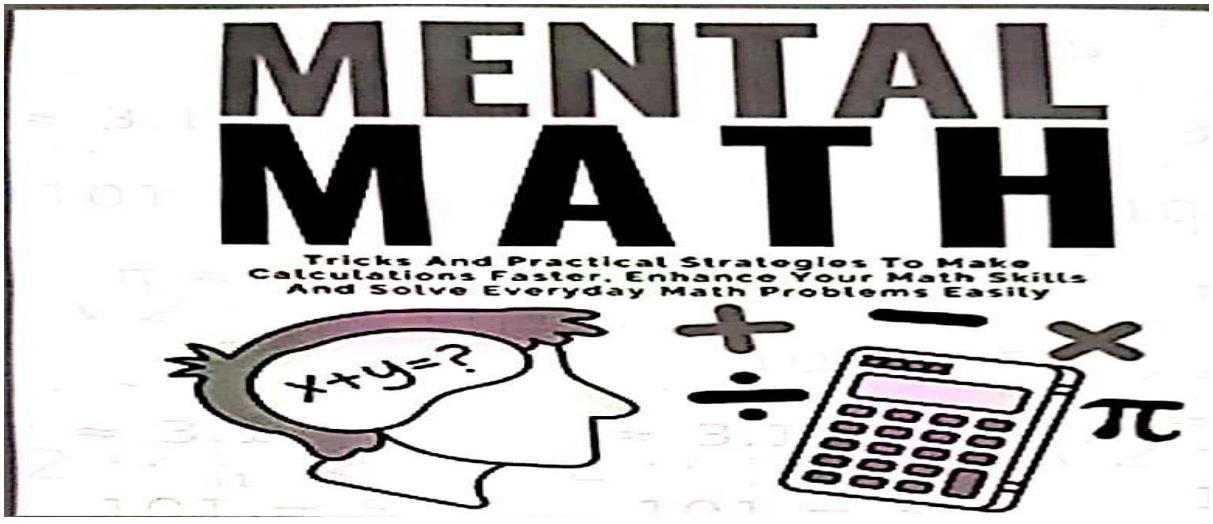


Figure 3.15 An image showing different techniques to make mental calculations easier

When I was at primary school, there were no exercise books; we used slates (as elaborated in Chapter Three), which were designed for the practice of writing and numbers during class time. It promoted learning by memorising rather than thinking and reasoning because there were no records of the previous day's work and we erased the writing to use the slate for another lesson.

We were supposed to keep what had been learned in our heads (learning by heart), and we survived because there were no other options. I can still recall some of the things I learned like that such as multiplication tables. This experience taught me that mental calculations in some situations are of equal importance as long as they are taught with understanding and are meaningful and realistic to the learners.

There are things that we need to know and carry them with us in our daily lives without having to refer to the book every time we need to use them, which is the basis of mathematics operations such as addition and subtraction of numbers and using fractions. Threfall (2002) mentions that mental calculations help learners to develop good number sense to trigger useful written calculations in the future. In the same way, Anghileri (2006) explains the number sense as the "person's general understanding of numbers and operations and to use this understanding in variable ways to make mathematical judgments and to develop useful strategies for handling number operations" (p. 5).

Teachers used to rush to complete the syllabus for examination purposes. The same can be said for the CAPS policy document and the Annual Teaching Plan which is designed to monitor the pace of teaching as it states what content to teach, when and the duration of the lesson. This leaves no room for slow and weaker learners, and once they experience a setback in their pace of learning, they would be lost forever. Hence, this is the reason why learners need to be taught and encouraged using effective methods of mental calculations to help them with their future written calculations (Threfall, 2002).

Reflecting on my memory stories where we learned through memorisation, I have learned that even though this method of learning was not an effective way of learning, mental work played an essential role in my educational journey, as I can recite the multiplication tables, the alphabet and numbers. This experience taught me to pay attention the first time the concept is introduced so I can easily recall it at a later stage. The very same skill can be used in today's mathematics class even though the skill of mental calculation cannot be taught in isolation, but it can be taught using different strategies throughout the teaching and learning process. Learners could be taught to look at different possibilities for numbers instead of one strategy. for example, when looking at the number five, rather than only looking at it as five items, the learner can look at it as a number after four, a number before six, and 4+1= 5, to develop the relationship between numbers.

Learning to teach and learn mathematics through games

Through my personal history I learned that my childhood school experiences of mathematics inspired games were part of our daily life experiences. When growing up, as soon as we learned to count, it meant you were qualified to play amagenda (see figure 3.2). Amagenda required concentration, throwing, and catching of the stone while counting. It was like we were competing outside the class on how good our mathematics skills were in the classroom. It also promoted creativity in learners and working independently because we used the knowledge taught in the class to create these games. I now realised the importance of using games in introducing and consolidating mathematical concepts and the application of mathematical skills in class. As supported by Kortjass (2019) who argues that numerical concepts such as counting, addition, and subtraction are developed through childhood games. Games form a great part of children's lives as they grow therefore, by playing games, a relaxed atmosphere is created as learners learn with ease without the fear of failure. Figure 3.16 is a Bingo game and other games for the teaching and learning of mathematics

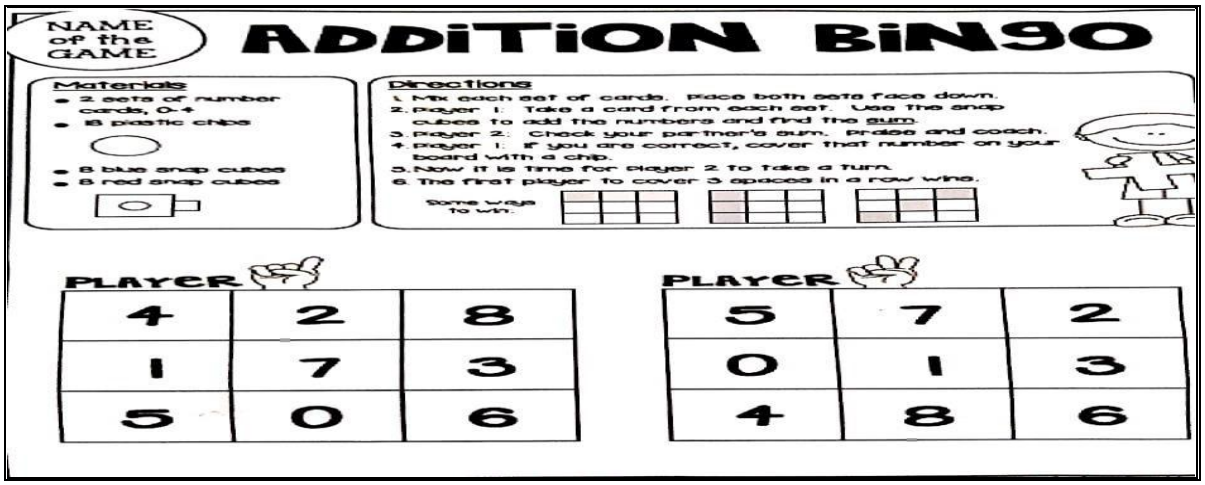


Figure 3.16. Bingo game and other games for the teaching and learning of mathematics

When reflecting on my primary school experiences, I see how games played a vital role in both my formal and informal learning as well how meaningful mathematics was to me at that time because most learnings were centred on games. Kortjass (2019) also states that when playing games, learners unconsciously learn many mathematical skills such as counting, subtracting, and adding. Teachers do not play any part in this regard, but as learners, we would find ways and means of taking the classroom environment to the playground and back to our homes.

When perusing my narratives on my past experiences, I realised how important it was to include mathematic games into the teaching and learning of mathematics. Way (2011) emphasises the importance of games in teaching mathematics as they "provide hands-on interactive tasks for both school and home."

Conclusion

In this chapter, I have narrated and discussed the memories of my informal and formal learning of mathematics. I discussed the impact my family and school learning of mathematics had on both my adult personal and professional life as well how it influenced my teaching. My recollections about mathematics learning helped me to bring to mind how I was taught mathematics at school. I have used memory drawings and old photographs to trigger these memories of my past experiences.

I travelled down this memory lane in order to develop myself as a mathematics teacher for the benefit of my learners. I discovered that the way I teach is greatly influenced by the way I was taught, and revisiting my past experiences has brought awareness of not repeating the mistakes of my previous teachers but correct and improve on them for the benefit of my grade seven mathematics class. This chapter afforded me with the opportunity of looking at myself through the eyes of the learner and understanding the frustrations and emotions they also go through if they fail to master some mathematical concepts. This whole experience has taught me to be patient with my learners, explore and use different teaching methods in my teaching and learning and to accommodate learners' diversity without it being a barrier to their learning.

In the next chapter, chapter four, I respond to my second research question: *How can I improve my practice of teaching and learning of number operations and number relationships?* To achieve this, I give a thorough description of my data analysis, from the detailed lesson plans I used to administer my lessons and the innovative strategies I adopted. I explain the use of the researcher journal and learner's journal during the course of this study, as well as the role my critical friend played during in my study.

CHAPTER 4

LEARNING FROM MY PERSONAL HISTORY

NUMBER OPERATIONS AND RELATIONSHIPS

Introduction

The focus of my self-study research was on teaching number operations and number relationships to grade seven learners. My intention with this self-study was to develop myself as an educator to successfully teach the concept of number operations and number relationships to my grade seven learners. In the previous chapter, I presented my life history as I responded to question: *What can I learn from my personal history about teaching and learning of number operations and number relationships?* I also discussed how I became fond of mathematics in my lower grades at primary school and the way we were taught during the Bantu education era and how this influenced the teacher that I am today. I also narrated how I can use my past experiences to learn and develop my practice.

In this chapter, I respond to my second research question: *How can I improve my practice of teaching and learning of number operations and number relationships?* I engage my class of 54 grade seven learners to help me respond to this question. In this chapter's introductory stage, I explained where I drew my content from in order to teach my learners. I discussed the procedure I engaged in when planning the lessons. When planning my lessons, I focused on how I will involve my learners in the lesson as well as engagement of learners and how I gathered my teaching resources.

Exploring content, preparation of lessons, and engagement of learners

The first thing that came to my mind when creating and planning for this content area was how I could teach familiar content differently and make my lessons different from the other lessons I have created over the past 13 years of my teaching experience. However, I still teach within the curriculum expectations as prescribed by the Curriculum Assessment Policy Statements (CAPS). However, I wanted to create a learning environment where learners bring knowledge from home and their everyday experiences to the classroom and use it for learning fractions (Bezuk & Cramer, 1989). I wanted to do this because learning fractions are difficult and primary school learners experience problems because of the complexity of fractional concepts.

I planned six mathematics lessons, four on common fractions, and two on decimal fractions. All the lessons were conducted in English as it is the Language of Learning and Teaching (LOLT) in our school. As a classroom-based teacher studying my practice, these lesson plans derived from the CAPS policy document and the content was based on what I was meant to teach. The intended curriculum stipulates that both common fractions and decimal fractions are topics that need to be covered under the focus area Numbers, Operations, and Relationships in Term 2. I worked within the timeframes stipulated in the policy document. I used the Annual Teaching Plan to structure my lesson plans, but only six of these lessons were elaborated on, in this study. The lessons were planned for two weeks and one day, which makes a total of eleven hours. Table 4.1 is the teaching plan for Mathematics Grade Seven for Term 2 as extracted from the CAPS policy document (DOE, 2011).

Table 4.1 MATHEMATICS TEACHING PLAN: TERM 2 GRADE SEVEN 2018

WEEK	TOPIC	CONCEPTS & SKILLS	CAPS	DBE WORKBOOK	DBE TEXTBOOK	DATE WORK COMPLETED	CURRICULUM COVERAGE
10-April _ April 13	Common Fractions hours	**Lesson 0:** Revision of Term 1 work or common test	49 - 50	74-93			
		Lesson 1: Ordering, comparing and simplifying common fractions- including specifically tenths and hundredths and extends to thousandths**.**					
		Lesson 2: Calculations with fractions- Add and subtract common fractions, including mixed numbers, limited to fractions with the same denominator or where one denominator is a multiple of another.					

		Lesson 3: Calculations with fractions- addition and subtraction of fractions where one denominator is not a multiple of the other.					
April 16 – April 20	**Common Fractions hours**	**Lesson 4:** Calculations with fractions- Find the fraction of the whole numbers and multiply common fractions, including mixed numbers, not limited to fractions where one denominator is a multiple of another	49 - 51	7493			
		Lesson 5: Calculation techniques- Convert mixed numbers to common fractions in order to perform calculations with them, use knowledge of multiples and factors to write fractions in the simplest form before and after calculations and use knowledge of equivalent fractions to add and subtract common fractions.		9497			
		Lesson 6: Solving problems involving common fractions and mixed numbers, including grouping, sharing, and finding fractions of whole numbers.					
		Lesson 7: Percentages-Calculate the percentage of part of a whole.					
		Lesson 8: Equivalent forms- Calculate percentage increase or decrease of whole numbers and solve					

		problems in context involving percentages.					
April – April	**Common fractions hour**	**Lesson 9:** Equivalent forms- Recognize and use equivalent forms of common fractions with 1-digit or 2-digit denominators and recognize equivalence between common fraction, decimal fraction and percentage forms of the same number	51 – 53	98- 109			
	Decimal fractions hours	**Lesson 1:** Ordering and comparing decimal fractions- including counting forwards and backwards in the decimal fractions to at least two decimal places, and write place value of digits to least 2 decimal places and round off decimal fractions to at least 1decimal places.					
		Lesson 2: Calculations with decimals- addition and subtraction of decimal fractions of two decimal places **and** extend to three decimal places.					
		Lesson 3: Calculations with decimals: Multiply decimals by 10 and 100)					
02 May– 04 May	**Decimal**	**Lesson 4:** Calculations with decimals- Multiply decimal fractions to at least three decimals by whole number.	51 – 53	98- 109			

		Lesson 5: Calculations with decimals- Multiply at least two decimal places by decimal fractions to at least one decimal place.					
		Lesson 6: Calculations with decimals- Divide decimal fractions to at least three decimal places by whole numbers.					
		Lesson 7: Calculation Techniques Use knowledge of place value to estimate the number of decimal places before performing calculations and use rounding off and a calculator to check results.					
May - May 07 11	**Decimal fractions 2hours**	**Lesson 8:** Solving problems- in context involving decimal fractions.	51 – 53	98-109			
		Lesson 9: Equivalent forms recognise equivalence between a common fraction, decimal fraction and percentage forms of the same number.					
		Lesson 10: REVISION					

Although the content was familiar to me, my intention was to teach this familiar content differently. To do this I had to seriously think about what resources I was going to use. Usually, as a teacher, the first resource you think of when planning a lesson is chalk, chalkboard, and textbooks. But this time I had to think about the different activities and different resources I was going to use when teaching numbers, operations and relationships.

As I was preparing and collecting resources, I had to think of all the stakeholders–the administration at my school, the learners, the parents and even the district office who could be of assistance to me. Firstly, I had to speak to the principal for permission to use our newly donated tablets. He favoured the idea of putting the tablets to good use before they form dust in the strong room. He even helped me and the newly formed school Information and Communication Technologies (ICT) committee, organise a workshop from our district office to train the whole staff on the use of these tablets. In our school we were fortunate enough, to be chosen at random by ALPLA an NGO company who donated 40 learners' tablets and one laptop to be used by the teacher. These tablets came in a secured trolley called the brITe box with one universal access point, one router and 100 gigabytes of data. Figure 4.1 is a photograph of the brITe box and figure 4.2 is a photograph of the trolley with 40 tablets for learners and one teacher's laptop.

Figure 4.1 The brITe box photograph of the trolley with 40 tablets for learners and one teacher's laptop.

The laptop and the tablets had specific applications (apps) preloaded such as Bubbles of maths, Drop words, Google handwriting, Maths workout and Pic Art Kids. As I was thinking of the resources to use in my teaching, I then saw an excellent opportunity of putting these tablets to use so I could improve my practice as a grade seven mathematics educator. Exploring different teaching styles using the tablets as a teaching resource, was also a way of doing things differently. The district office sent an Information Technology (IT) technician who came with two assistants and taught us how to use the tablets in class to enhance teaching and make learning more fun and

effective. They also taught us how to search for information on the internet, download it, and then upload it to the tablets.

In being creative and coming up with new ways of teaching, I had to bring the learners and parents on board as well. They contributed some of the teaching resources. Some of the resources such as counters I had to organise myself and some, I had to ask learners who had them to bring it to class. Counters are tools that children can use in their attempts to master mathematics skills including counting, adding, subtracting, making patterns and comparing numbers. I also asked other teachers in the school to assist. To give an example, on Mondays, as part of nutrition programme, the learners eat sour milk (maas) and phuthu (hard porridge made with mielie meal) and each class gets 3 bottles of 4 litres each of mass. I then requested the teachers to keep the maas bottle tops for my class and I used it for various activities in class.

After my teaching process, where I responded to teaching number operations and number relationships to grade seven learners, I generated data for this study from my interaction with learners, the curriculum, and my reflections on my teaching. I then analysed this data using a thematic analytical approach after consulting Braun and Clarke (2008). They explain that thematic analysis is a "technique to recognise, examine, and report patterns (themes) within data" (p. 79). According to Braun and Clarke (2008), there are six phases of analysing the data, namely: i) familiarising yourself with the data, ii) generating initial codes, iii) searching for themes, iv) reviewing themes, v) defining and naming themes, vi) producing the report. I chose to use this method because it helped me search for meanings and patterns in the data set to get an accurate reflection of the data I generated.

Analysing the generated data

When analysing my data, I sorted the generated data such that I could identify similarities and relationships between data pieces. To achieve this, I followed the example of Braun and Clarke (2006) when they said that phase two of thematic analysis is called generating initial codes. I gathered all the data that I had already generated and spread it out on the floor. Figure 4.3 is a photograph of the generated data spread out on the floor.

Figure 4.2 Photograph of data spread on the floor

The data included the lesson plans, learner's journals, researcher journal, charts from presentations I had with my supervisor and my critical friend accompanied by notes I took during our meetings. The data also included the policy document (CAPS) with an annual teaching plan, timetables, games we played in class and pictures from learners' activities. While on the floor, I grouped common concepts using coloured sticky notes to connect similar items. Figure 4.4 is a photograph of the data with coloured sticky notes pasted to make connections**.**

Figure 4.3 Photograph of the data with coloured sticky notes pasted to make connections

At this stage, I used the same colours as the sticky notes to code the data. After coding the data, I collated all the data into groups identified by the code to summarise the main points and common meanings that appear repeatedly in the data. The grouping and coding data process helped me generate and identify themes for my data. Braun & Clarke (2006) recommend using themes to summarise something important about the data concerning the research question which denotes some meaning within the data set.

I then required a tool that was to assist me in making sense of what it was that I came to understand about my teaching. To help with this level of analysis, I used a collage as an analyses tool. Figure 4.5 is the collage with the different themes.

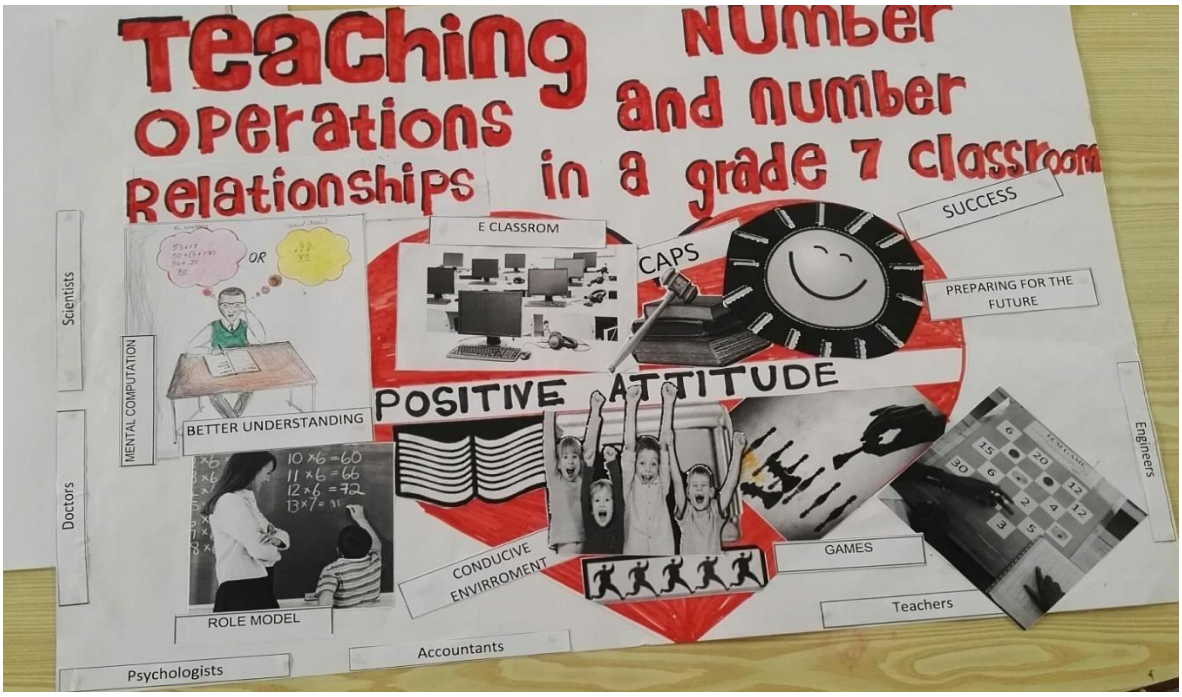


Figure 4.4 The collage with the different themes

I used a collage as part of the analytical process to identify the themes that emerged from my data and also to help me present the themes to my critical friend and supervisor. As I was creating themes, I reflected on what the data was saying and the contributions made by my supervisor and my critical friend. One of the suggestions was that I must give my themes titles that are selfexplanatory so that the readers of this thesis will be able to identify the meaning in the themes. The first theme was “using manipulatives in my grade seven mathematics class," but they suggested I rephrase it to “hands-on learning through manipulatives" which sounds better as it gives a clear understanding of the theme. As I was working on the themes, I also discovered some interesting methodological learnings that I will use to facilitate my lessons.

Themes that emerged from the data analysis

Hands-on learning through manipulatives

Working with my learners, I realised the importance of allowing learners to be hands-on while learning numbers, operations, and relationships. I began to understand that when you provide tangible learning materials which learners can touch and manipulate, they become engaged in the lesson.

Manipulatives are physical objects used as teaching tools to engage learners in the hands-on learning of mathematics (Moyer, 2001). These objects can take any form of a visual object that learners can manipulate when doing hands-on activities. They can be used in various ways for instance when introducing a new lesson, reinforcing what is learned, or remediating a concept. I wanted the learners to use their other senses for example the sense of touch because mathematics is usually seen as a cognitive activity where the most commonly used sense is listening.

When learners are actively touching objects where they use more than just a sense of thinking, they learn more and the fact that they are working collaboratively in groups, extends their learning. The activity encouraged them to use other senses, which are also of equal importance for them to adopt a holistic approach to learning. Manipulatives, models, and other hands-on activities are an effective means of strengthening the sense of touch. Bezuk and Cramer (1989) stress the importance of using manipulatives in developing learners' understanding of fractions.

I will now share the lessons that brought this understanding to light for me as I worked with my learners. For the introduction of lesson one, I used dictionaries as manipulatives in order to probe discussions relating to the topic and used the known to get to the unknown. Figure 4.6 is a photograph of learners using dictionaries to find the meaning of the given mathematical terms.

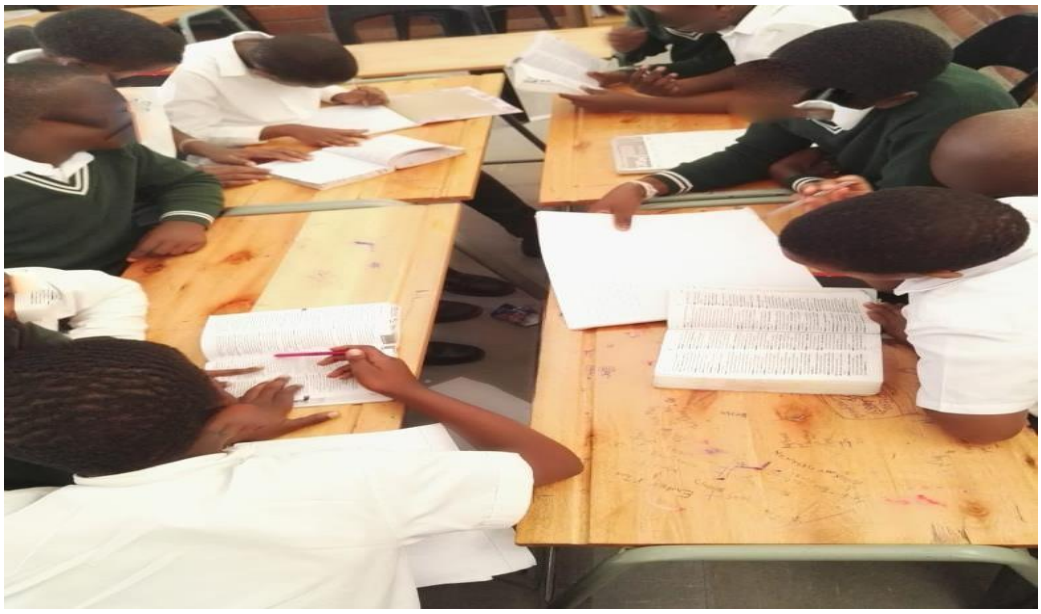


Figure 4.5 Photograph of learners using dictionaries to find the meaning of the given mathematical terms.

The aim of using these visual (dictionaries) tools was to make the examples in mathematics more concrete, accessible, and comprehensible (Naidoo, 2012). Learners in groups had to use dictionaries to find the meaning of the terms: fraction, numerator, denominator, whole, fair, justice, part, sharing and equally.

I wanted the learners to practically go through the words at the top of each page as a guide in the dictionary to find the given words first, then have short discussions of these terms in their groups. In their discussions, they had to give real-life examples of each term or word. Then they had to elect one member from each group to present their findings in front of the class. Figure 4.7 is a photograph of a learner sharing with the class what transpired during group discussion.

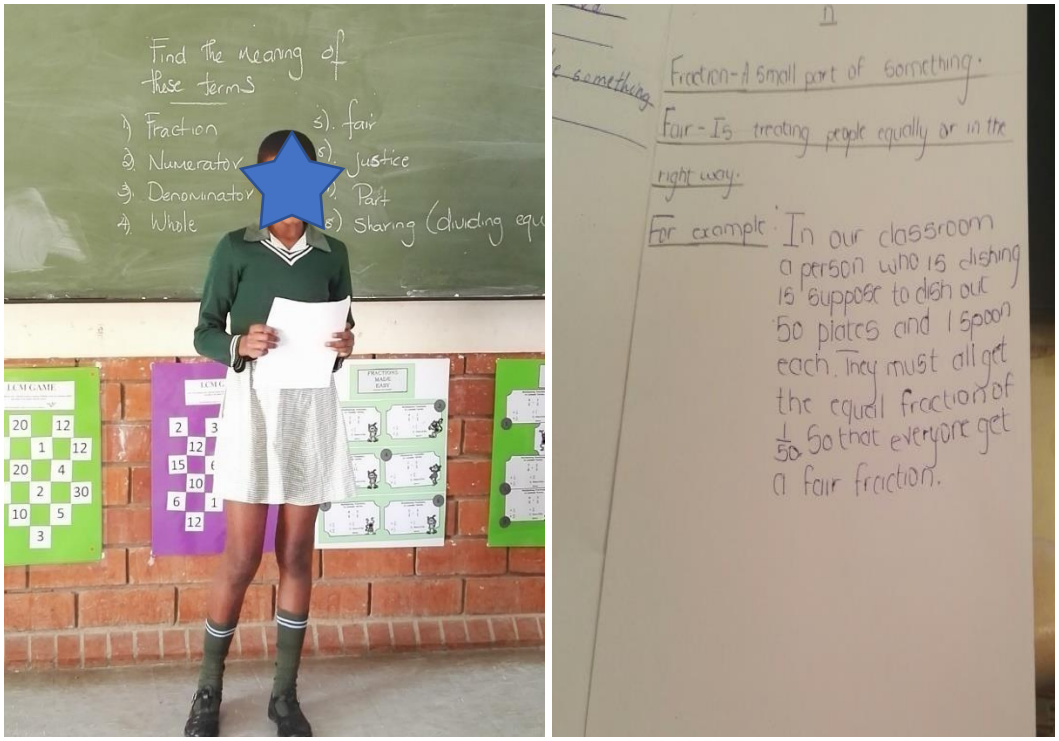


Figure 4.6 Photograph of a learner sharing with the class what transpired during group discussion

As they were presenting, the whole class, including myself as their educator, participated in the discussions. I wanted them to do this because I needed those who did not get the opportunity to find the meaning of the words in their groups, to hear it and understand its meaning from the class discussions. These discussions also helped me as an educator, to further facilitate the explanations of the words to ensure that every learner had the same meaning.

This lesson helped me realise that in mathematics, the first lesson does not need to be about me writing on the chalkboard, it can take the form of discussions and practical activities where learners

use manipulatives. For this lesson, I used dictionaries to initiate discussions relating to the topic and using the known to get to the unknown. The examples that the learners came up with in the discussions were excellent and shocking. It shows that learners have the knowledge, but the problem is that they see mathematics in isolation to the real world and other subjects. Therefore, my duty as a teacher is to make them realise that this is not the case. When one of the groups presented the relationship between fraction and fairness, I was taken aback by the examples they provided using the newly researched terms. They pointed out that:

> *When the teacher comes to class and finds the class making noise, and she punishes the whole class instead of punishing only those who made a noise, it becomes unfair to those who never made noise*

Another learner from a different group also stated that*:*

If we are given a project as a group, and some people do not participate in the group work, it is fair if the teacher does not give those marks".

When they expressed that, I came to understand that learners can make meanings of the things that I do in class but I am not aware of this as an educator. This experience taught me to be aware of myself and the environment I create as an educator in class and also to be more aware of the learners' capabilities instead of assuming they are not capable of comprehending me.

After the discussions and explanations on the introductory lesson, I needed to make sure I provided them with an opportunity to actively engage with this new knowledge in the next lesson using manipulatives to enhance their learning experience of fractions. To do this, I used sweets to make the abstract concept of fractions hands-on and concrete. In groups of six, I gave each learner a pack of multi-coloured sweets with a paper plate. I asked the learners to open their sweet packs on the plate and count each sweet in their packs in each group. I reminded them that the total number of sweets was their denominator. Their task was to state what fraction a specific colour of sweet represents out of the total number of sweets. I reminded them that the specified number of sweets of the same colour would be the numerator, and the total number of sweets will be the denominator. Figure 4.8 is a photograph of the different coloured sweets representing the numerator in a fraction.

Figure 4.7 A photograph of the different coloured sweets representing the numerator in a fraction.

I asked them the following questions:

Teacher: What fraction of the total number of sweets are blue?

Learner: $\frac{4}{20}$

Teacher: What fraction of the total number of sweets are pink?

Learner: $\frac{4}{20}$

Teacher: What fraction of the total number of sweets are yellow?

Learner: $\frac{2}{20}$

Teacher: What fraction of the total number of sweets are Green?

Learner: $\frac{1}{20}$

Teacher: What fraction of the total number of sweets are purple?

Learner: $\frac{5}{20}$

They wrote the fractions on the paper plate.

Another opportunity to use manipulatives also came up when introducing equivalent fractions to the learners. The learners had to create their fraction charts using narrow strips of chart paper of equal length. Furner and Worrel (2017) argues that manipulatives play a significant role in making mathematics concepts concrete rather than abstract. The learners used fraction strips to represent

each addend, and they then added fractional parts to find the sum. Figure 4.8 is a photograph of learners creating a fraction chart.

Figure 4.8 is a photograph of learners creating a fraction chart

In this lesson, I wanted the learners to discover the relationship between fractions and what equivalence means using fraction charts that they made themselves. The fraction chart is a very effective tool to use when teaching learners how many units of fractions could fit into the whole. Below is a narrative of the mathematics lesson on equivalent fractions

The first strip represented one whole; the next strip was divided into two halves, and each marked ½. The next strip was divided into three equal parts, and each strip was marked 1/3. The pattern continued till all strips were divided to obtain smaller and smaller strips. The learners using the fraction strips answered questions such as "how many one-thirds make up one whole?" They used the fraction chart to find the answer, and they marked the first 1/3, the second 1/3, and the third 1/3, then found that together they equal to one whole. Almost all learners found it easy to answer with the help of the fraction chart.

When the learners finished making fraction charts, they used the charts to answer the following questions:

Teacher: What fraction has a numerator eight and is equivalent to $\frac{1}{2}$

Learner: $\frac{8}{16}$

What other fractions are equivalent to $\frac{1}{2}$ Learner

1: $\frac{3}{6}$

Learner 2: $\frac{2}{4}$

I wanted the learners to understand

My reflection on the lesson

As learners were doing this activity, I observed that it was more straightforward for them to find equivalent fractions if they looked at pictures (fraction charts) as it makes them physically see which fraction is equivalent to the other. It is more difficult when numerical fractions are used instead of a picture. I also discovered that creating and using fraction charts can be a fun way for learners to discover more facts about fractions that they did not comprehend before and it also enhanced their confidence about doing calculations on fractions.

As a teacher, I understood that equivalent fractions are such an essential concept for learners to understand. But with time pressures and being on par with the annual teaching plan, it is the norm for educators to skip these fundamental activities and move on to the procedural activities.

Bringing technology into my grade seven mathematics class

Learners nowadays are born in a world of technology hence they are colloquially called “digital natives.” In contrast, most of us educators are still trying to fit into the technological world we were not born into hence, we are called digital immigrants. The aim of integrating technology in my lessons was to enhance and develop the teaching and learning strategies because technology appears to transform pedagogy (Hardman, 2005). Using different forms of technological tools like YouTube, computers, tablets and smartboards is a way of speaking to who they are. It helps in assisting the learners to see the content come to life through technology. The above statement explains that we cannot exclude technology in today's classroom as a teaching and learning tool because learners are more likely to be visual learners because of their familiarity with technology.

Technology tools like computers, when effectively used, may improve students’ mathematics accomplishments and enhance the overall learning environment (Mistretta, 2005). Learners are averse to learning multiplication tables using the drill method. Most of them say frankly that, "I do not know my multiplication tables." Caron (2007) refers to this as the confidence of failure. To motivate learners in my lesson with adding and subtracting fractions of different denominators, I used tablets to practice their multiplication tables and multiples of numbers instead of using the

multiplication tables written in their mathematics exercise books. Figure 4.9 is a photograph of learners using tablets to practise multiplication tables.

Figure 4.9 Photograph of learners using tablets to practise multiplication tables

The application (app) on the tablet is called “Bubble Math” with various activities (games) that encourage mental calculations and learning multiples in a fun way. The fact that they were using tablets, they were more focused and they did not realise that they (learner) were the ones doing the calculations, not the tablet. This was a warm-up activity to introduce the concept of finding the lowest common multiple (LCM) if denominators are not the same, before adding or subtracting fractions. Fractions are defined by their denominators, if denominators are the same therefore those fractions are of the same kind whereas LCMs have to be constructed when adding and subtracting fractions with different denominators. To find the LCM, learners had to use the knowledge of common multiples i.e., what number can both denominators be divided into without leaving a remainder.

I explained to the learners how to choose an LCM using the following examples: Example

1

Teacher: Here are the first few multiples of 6:

6, 12, 18, 24, 30…

Furthermore, are the first few multiples of 8?

8, 16, 24, 32, 40

The LCM is the first time the multiples of 6 meets the multiples of 8: What is the LCM of 6 and 8?

Learners: 24

To find answers, learners had to go through the multiples of the larger number on the calculator from the tablet until they reach the common multiple of a smaller number.

Example 2

Teacher: Find the LCM of 9 and 12 by going through the multiples of 12 till you come to the multiple of 9.

Learner 1: *36 is the first multiple of 12 that is also a multiple of 9*

Learner 2: *36 is the LCM of 9 and 12.*

Reflection

From this lesson, I observed and learned that tablets could support under-achieving learners in learning mathematical concepts in a more relaxing environment. I had a learner in my grade seven class that had always been a problem, interrupting other learners during the lessons. But to my surprise, in this lesson when we were using tablets, he behaved very well, and he even offered to assist me with other learners who encountered problems with their tablets, pointing out that he will use computers to mix songs as a music producer when he grows up.

I feel that technology in class pushes the boundaries of pen and paper and gives access to other technological resources that can also be useful in the classrooms. Again, to bring the technology element into my grade seven classroom, I also used a projector and the projector screen when consolidating the work on adding and subtracting fractions. Figure 4.10 is a photograph of learners watching an online lesson on addition and subtraction of fractions.

Figure 4.10 Photograph of learners watching an online lesson on addition and subtraction of fractions

The learners watched an online lesson on adding and subtracting fractions, but the online tutor's methods differed from what the learners learned in class. This method was called the butterfly method and as they were watching, I paused to explain and ask questions to check if they were still following, but I could tell I was disturbing them, judging from the way they were glued to the screen.

At the end of the online lesson, I asked them:

Teacher: *Which method to do you prefer or do you think the butterfly is better than the method I taught you in class*

Learners: *(majority shouting excitedly): The butterfly method*

Figure 4.11 is a screenshot of the butterfly method of adding and subtracting fractions

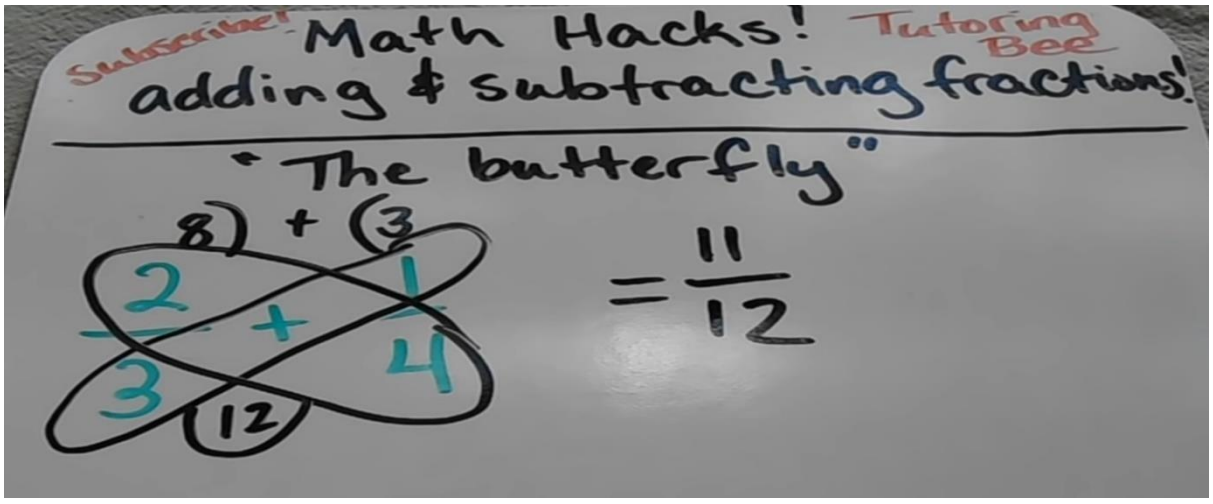


Figure 4.11 A screenshot of the butterfly method of adding and subtracting fractions

Classroom activity

I asked learners to get into groups and choose one method (traditional method learned in the class where you start by finding LCM or the butterfly method). In their respective groups, I gave them a blank chart where they were required to summarise what they had learned on how to add or subtract fractions with different denominators or write rules for adding and subtracting fractions with examples.

Reflection

Bringing technology into my mathematics class helped to enhance the lesson, motivated and excited learners. Using downloaded online lessons to emphasise and consolidate what was already taught, helped my learners better understand using an alternative method.

A vibrant visual environment that is conducive to learning

I know that decorations in class do not make me a good and effective mathematics teacher. Whether learners like my class or not, also does not make them like and understand mathematics. Transforming my classroom into a conducive classroom created a positive teaching environment and encouraged learners to own that space, which is our classroom. In so doing, they all took pride in the work we produced inside the class. Figure 4.12 is a photograph of my grade seven mathematics classroom.

Figure 4.12 Photograph of my grade seven mathematics class

Our school is located in a semi-informal settlement where most learners are coming from disadvantaged family backgrounds. Many are orphans raised by grandparents, and others come from child-headed households, and as young as they, they carry much responsibilities on their shoulders. In one way or the other, they are affected or infected with HIV/ADIS. Once a month, most learners have to absent themselves to go to the clinic for either themselves or their sick parents. Hence, the reason I decided to use the classroom to motivate my grade seven mathematics learners was to forget about their dire situations and find some happiness once they entered the mathematics classroom. The merrily decorated classroom also helped to alleviate their stress. As the CAPS policy document clearly states, the aim of the curriculum is to "equip learners, irrespective of their socio-background, race, physical ability or intellectual ability with the knowledge, skills, and values necessary for self-fulfilment, and meaningful participation in society as citizens of a free country" (DBE, 2011) With my extra efforts, I was trying to fulfil this philosophy.

Naidoo (2012) argues that the use of colour and visual tools creates an exciting mathematics classroom, which was another reason I decided to incorporate visual mathematics into the

classroom by reconstructing the grade seven classroom into a conducive classroom to cultivate positive learning. Using visual tools in the teaching of mathematics also helps in communicating the process of reflection to the learners. Hence, learners who cannot recall learned work could be quickly assisted. Figure 4.13 is a photograph of the brightly coloured and interesting fraction wall in my classroom.

Figure 4.13 A photograph of the brightly coloured and interesting fraction wall in my classroom.

Mathematics carries many stigmas, anxiety and myths where learners are still under the impression that not everyone can master mathematics. As part of reconstructing my grade seven class, I decided to add visual aids on the walls to help lower their mathematics anxiety and build mathematics vocabulary. The purpose was to support and encourage the under-achieving learners to answer questions independently using visuals on the walls as guides. Hobden (2012) argues that some of the causes of mathematics anxiety is when teachers do not have patience with learners who have little understanding and mock them for their mistakes in front of other learners. I even included some motivational charts on the sidewalls to show them that mistakes are allowed as long as we learn from them.

Our school is a full-service school that caters for learners with learning barriers. As I created my mathematics fraction wall, I wanted to give my learners ongoing support to be reminded daily of the previous lessons and use of the wall as a reference. I included number charts with all types of

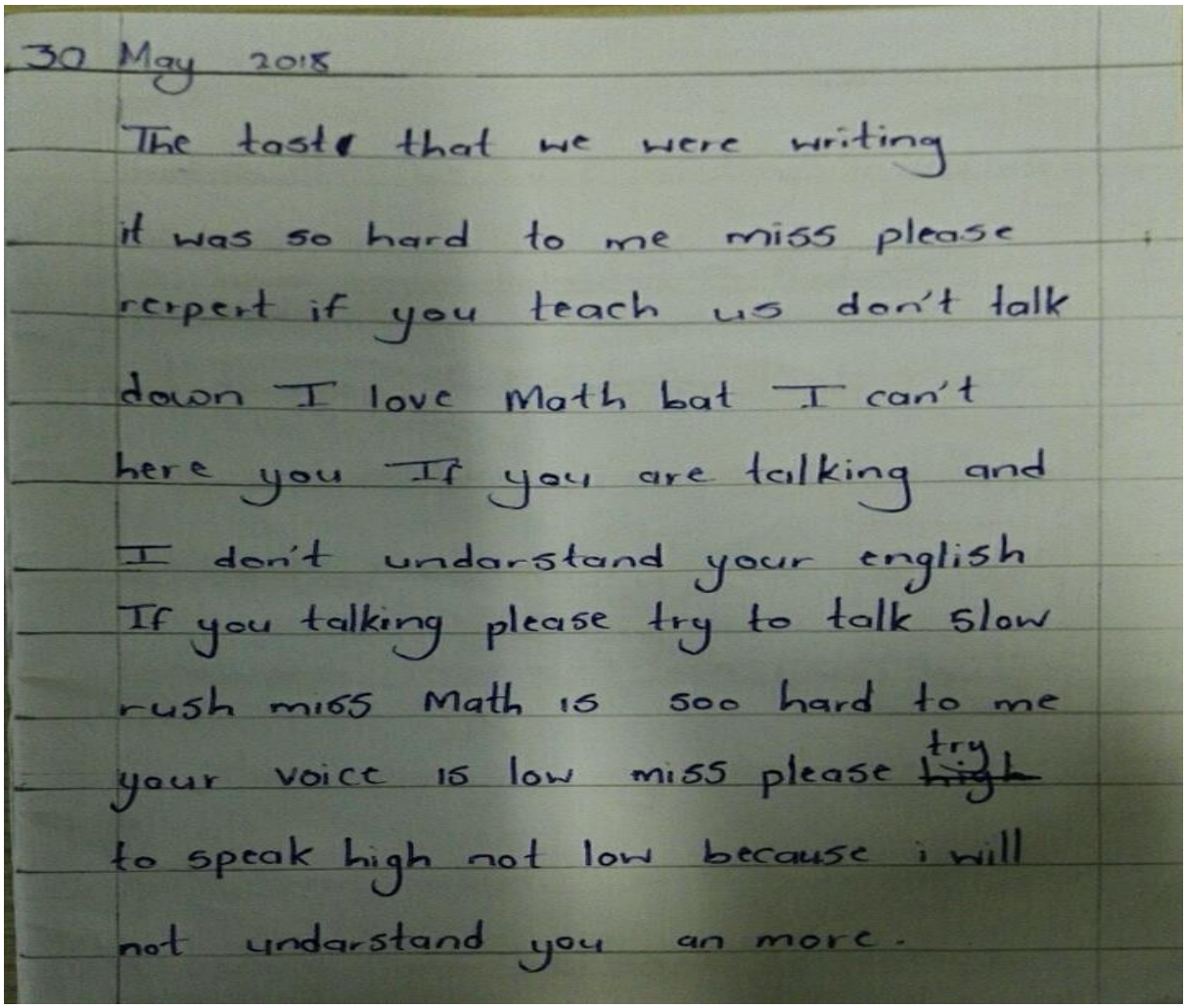
numbers at the front of the classroom, such as prime numbers, composite numbers, square numbers, cube numbers, and number properties to reinforce all the work taught.

Learning through researcher and learner journals

As part of this journey, I planned to use journals in the reflective process such as the researcher journal and learner journals (see chapter two). Ortlipp (2008) argues that keeping a journal creates an atmosphere of transparency throughout the research process, where the researcher examines personal assumptions and goals. I wanted the learners to reflect on how they perceived the new pedagogies to teach mathematics. I also used the researcher journal to share my experiences and establish trustworthiness for my study.

Learning about myself through learner journals

The journal writing process helped me understand how learners see me as their teacher and how they perceived the teaching and learning process. It also taught me who I am as a teacher and how I teach and present myself to them. This learning became very clear when I read some of the learner's journals. Some of the learner journals' reflections helped me see things that I was not aware of as a teacher that hindered effective teaching and learning. One learner wrote as a journal entry that the reason for not performing well in mathematics, was because of my soft voice, and that helped me improve my voice projection in the next lessons. Figure 4.14 is a screenshot of a learner's journal entry.


30 May 2018

The tast that we were writing
it was so hard to me miss please
rerpert if you teach us don't talk
down I love Math bat I can't
here you If you are talking and
I don't understand your english
If you talking please try to talk slow
rush miss Math is soo hard to me
your voice is low miss please try ~~high~~
to speak high not low because i will
not understand you an more.

Figure: 4.14 Screenshot of learners' journal entry

Here for clarity, I provide the learners' journal shared in figure 4.14

> The tast that we were writing it was so hard to me miss please rerpert if you teach us don't talk down, I love math bat I can't here you if you are talking and I don't understand your English if you talking, please try to talk slow rush miss math is so hard to me your voice is low because I will not understand you an more

When I read this journal entry, it stood out for me and I reflected in my researcher journal on how sad it made me feel. It made me realise that not only the content and methodology matter in the classroom. Other issues of which we are not aware for example the volume of my voice, and the language used during teaching are equally important. In future, I will take this into consideration whenever I plan for my lessons and not just concentrate on the content but on other factors that also affect the teaching and learning. Below, is my journal entry.

Today I was a little bit saddened when I read one of the learner's journals. The learner commented about my voice projection and said I was too soft; thus, she/he failed the test because it was hard to hear my teaching. This made me reflect on all the learners I have taught and regarded them as learners with learning barriers and only to find that my voice) was a barrier to their learning. (Personal Journal Entry 20 April 2018)

Reflection

For the past 13yrs, that I taught Mathematics in grade seven, I have never understood the effectiveness and the power of a reflective journal for both teacher and learner until I engaged with it in this self-study. I used to think that learners only reflect through classroom activities, homework or formal assessments. As for the teacher, it used to be just one simple line at the end of the lesson plan. I would state whether the learners were able to finish the given task or whether they understood the lesson or not. This self-study taught me different innovative methods of improving mathematics teaching and learning in grade seven. I learned that reflection provides both the teacher and the learner with the opportunity to think deeply about the lesson and look at the lesson's strengths and weaknesses.

Learner's engagement in the lesson

As reflected in my researcher journal, during the mathematics lessons when introducing journals to the learners for the first time, the learner's excitement taught me that, when I introduce a new concept that requires cutting and pasting it arouses interest and the eagerness. Figure 4.15 is a screenshot of learners' reflective journal covers with pseudonyms.

Figure 4.15 Screenshot of learners' reflective journal cover with pseudonyms

Learners were so enthusiastic and they actually wanted to know what was going to happen in next lesson. As I watched them putting these reflective journals together, it gave me a sense that when opportunities are open to the learners where they feel as they are part of the creation, it gives them a sense of owning the lesson. Below is my reflection from my journal entry.

> *Today I asked my grade seven mathematics class to create their journals. I had to explain what a reflective journal is and what its purpose is. I also explained that they had to use false names on the cover of their journals to guarantee the confidentiality and trust that I will never use what they have written against them. They looked very puzzled, but immediately, when I gave them the A5 blank copies cut and stapled together and asked them to design the cover and write their false names, they were excited. I was relieved, but I still have concerns about whether they will still be this excited when they start writing their journals the following day.* (Personal Journal entry: 11 April 2018)

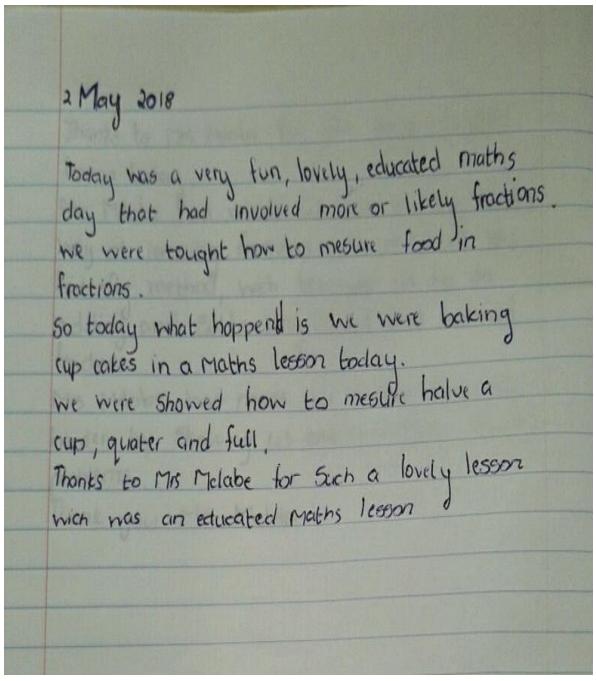
Reflection

Reviewing what I have recorded in my journal helped me make informed decisions when preparing for the next lessons. Spalding & Wilson (2002) speculate that "as instructors, we benefit because journals serve as windows into our students thinking and learning." However, working with the learners and the journals, I also found my teaching of mathematics in the classroom more profoundly meaningful.

Learner's feelings about working with each other

As a teacher, I have never been in favour of group work in the classroom until I engaged in this self-study. The journey of my personal history afforded me the opportunity to revisit my primary and high school experiences in the classroom, where I remembered that I was a shy and reserved student. Working with others in a group felt uncomfortable and awkward, I felt it also robbed me of the opportunity to shine as the top achiever because collaborative work means the same mark is awarded to the hard-working students who does all of the work and also the lazy students who do nothing. This experience made me realise that this is the reason why as a teacher, I rarely used group work in my class. I provided justifications for not engaging learners in group work. Some of the excuses included the fact that learners will talk about everything but what they were supposed to be talking about.

Engaging in this self-study made me see group work in a different light, as I was exploring different methods to teach numbers, operations and relationships in my grade seven class. This revelation was also confirmed by the responses I got from the learner journals after one of the group work activities they were involved in. Figure 4.16 is a screenshot of a learner's journal entry and Figure 4.17 is a photograph of learners baking.



2 May 2018

Today was a very fun, lovely, educated maths day that had involved more or likely fractions. we were tought how to mesure food in fractions.
So today what happend is we were baking cup cakes in a Maths lesson today.
we were showed how to mesure halve a cup, quater and full.
Thanks to Mrs Molabe for Such a lovely lesson wich was an educated Maths lesson

Figure 4.16 Screenshot of learners' journal entry

Figure 4.17 Photograph of learners baking

The baking activity happened when I was consolidating a mathematics lesson on fractions where learners had to get into groups and plan for the baking lesson the following day. I had to ask parents for baking ingredients and learners were more than excited to do so. I gave all the groups the same

recipe with measurements in form of fractions where they had to delegate work among themselves as to who will bring what from home. I was even more surprised by the team spirit they projected to make sure their group scored the best mark. They even went as far as allocating amongst themselves, the person who will narrate the baking process for example setting the scene, creating paper-caps for the chefs and making sure all the ingredients were available before they start baking. Figure 4.18 is the recipe for the group activity of baking.

CHOCOLATE CHIP COOKIES

1 Cup Butter

2 ¼ Cups All Purpose Flour

¾ Cup White Sugar

1 ½ Cups Chocolate Chips

2 Large Eggs

1 ¼ Teaspoon Vanilla Extract

1 Teaspoon Baking Soda

Figure 4.18 Recipe for the group activity of baking.

We normally do group work in class, and we always assume that learners are receiving it well, but when it is validated by the things the learners say in their journals (see figure 4.16) it gives an assurance that group-work is an effective teaching method as evidenced by Figure 4.19 which is a photograph of learners sitting in groups planning the baking activity.

Figure 4.19 Photograph of learners sitting in groups planning the baking activity

Conclusion

In this chapter, I addressed my second research question: *How can I improve my practice of teaching and learning of number operations and number relationships?* Answering this question, I involved my grade seven learners in lessons I conducted in the classroom to explore the innovative strategies in teaching numbers, operations and relationships. I discussed the data analysis method that I employed to analyse the data and the themes that emerged from the data analysis. I also gave a detailed description of how I used these strategies in the lessons I conducted. The teaching methods were inspired by the themes: hands-on learning through manipulatives, bringing technology into grade seven class, and other interesting pedagogical learnings. Lastly, I shared my reflections from the researcher journal where I narrated the strengths and limitations of the lessons I taught. I also shared learners' thoughts from the learner journals on how they perceived the teaching and learning of numbers, operations, and relationships.

CHAPTER FIVE

LEARNING, REVIEWING AND REFLECTING ON MY SELF-STUDY RESEARCH JOURNEY

Introduction

This self-study focused on my professional development as a grade seven post-level one, classroom-based educator in teaching and learning number operations and number relationships. I aimed to find innovative teaching strategies to teach the love and understanding of numbers, operations and relationships to grade seven learners. I felt that many issues affect learners' performance in mathematics, starting with teaching and learning. In the previous chapter, I responded to my second research question for this study: *How can I improve my practice of teaching and learning of number operations and number relationships?* When responding to this question, I learned that it is essential to explore and incorporate different teaching styles in one lesson to stimulate learners' interests in the topic.

In this last chapter five, I reviewed this research by briefly explaining what transpired in the previous chapters and key learnings from each chapter. I then discussed my personal and professional learnings and the new aspects I discovered about the topic. Looking at what I did not know before I engaged in this study, I changed my teaching practice for the better. Lastly, I reflected on my methodological learning from this research and the new teaching methods I adopted in teaching numbers, operations and number relationships.

A review of the dissertation

Chapter One

I discussed my study's focus on improving my teaching of numbers, operations, and relationships in my grade seven classrooms. The motive was to enhance numeric skills in grade seven learners who had not mastered these fundamental skills. I then explained and discussed my two research questions that guided my study and how I responded to them throughout the study. Lastly, I discussed the Realistic Mathematics Education (RME) theoretical framework that helped me understand my key concepts: *teacher learning and enacted curriculum*.

Chapter Two

I put forward a detailed account of my self-study research process. I identified and explained my methodological approach, which is self-study. I further described the study's location and the research participants and my critical friend and her contribution to my research study. Furthermore, I described how I generated data using varied research practices and how they helped me respond to my research questions. I also explained the procedures I followed to obtain ethical clearance from the university and the DBE and consent from my school principal, my grade seven learners and their parents. Lastly, I gave the details of the challenges I experienced that affected my research study and how I dealt with them. In conclusion, I highlighted this chapter's critical message, which helped me learn more about different strategies and tools to develop my practice.

Chapter Three

I responded to my first research question: *What can I learn from my personal history about teaching and learning number operations and number relationships?* I narrated my formal and informal lived experiences of my engagement with mathematics in my early childhood, primary schooling, high school years and tertiary education. To explain my personal history, I included visual images, photographs and drawings. I then explained the use of a collage. I showed how presenting it to my supervisor and my critical friend helped me recall some of the long-forgotten memories of my past. I also elaborated on how these memories influenced the teacher that I am today, and I finally elaborated on the lessons learned through my positive and negative lived experiences and how I could use them to improve my practice as a grade seven mathematics teacher. I learned the importance of supporting and understanding the role I played in learners' lives inside and outside the classroom.

Chapter Four

I responded to my second research question: *How can I improve my teaching and learning of number operations and number relationships?* I elaborated on using prepared lesson plans and reflected on mathematics lessons with my grade seven learners. I used my reflective journal to disclose my thoughts and feelings and I showed how my teaching and learning progressed. I also revealed some of the learners' reflective journals on how they perceived the prepared lessons using the RME theoretical framework as a guide. I created a collage to analyse my observations and discoveries after engaging with the learners through planned activities from the lesson plans.

Lastly, I discussed my critical learnings from engaging with my grade seven learners. I explained how I learned that tapping into learners' interest by using technology such as tablets and a projector in teaching and learning, always captures learners' interest.

Chapter Five

In this last chapter, I finish by reflecting on what I have learned from my self-study research, I begin with my personal learnings and then reflect on my professional learnings. I then explain how I planned to use what I have learned to move forward with teaching numbers, operations, and relationships to my grade seven learners.

Using a collage to present my introspective learnings from the study

To present my learnings from this self-study journey, I chose to employ collage making. I needed a tool that would help me analyse my lived experiences and my data representation. Van Schalkwyk (2010) states that a collage is a poster or visual representation where the participant uses photographs, images and prints that include text from magazines and other media, and any other printed material telling something about them. Constructing a collage helped me reflect on what I was learning as valuable discoveries for teaching numbers operations and relationships. Collage can reveal our view of the world, our assumptions about it and our understanding (Hamilton & Pinnegar, 2009). I shared the collage that communicates what I consider as the most important lessons I have learned emanating from this self-study research journey. These learnings are *a) Aligning myself with other mathematics teachers through committees and cluster meetings b) Reimagining my enactment of the mathematics curriculum policy c) Seeing learner voice and participation as an asset in teaching and learning d) Knowledge of learners - teachers instruction tailored to meet each learner needs*

Figure 5.1 A metaphoric collage representing my methodological and conceptual learnings of my research journey

My learnings Learning 1: Aligning myself with other mathematic teachers through committees and cluster meetings

Figure: 5.2 Image of people holding hands representing teachers working together

I used to shift the blame to previous teachers from the foundation and intermediate phase for my learner's poor performance in numbers, operations, and relationships. Self-study has helped me understand that effective teaching and learning can happen if other teachers of the same subject and I can meet, plan, discuss, and share ideas. Engaging in this self-study research gave me the courage to revive the mathematics subject committee in our school, as the existing one was there in name only. I then requested permission from the office, which the principal granted, to meet with mathematics teachers from our school, where I presented my vision of working together as a team. We then drafted our two-year improvement plan to look at how we can best equip learners with the fundamental number-skills in primary school. This committee is used as a platform to improve teaching and learning significantly. As teachers, we can identify both learners' and teachers' weaknesses and strengths and then develop a mathematics improvement plan on the number, operations, relationships, and other mathematics areas. Bertram (2011, p. 12) states that "professional development that is school-based, happens where teachers are active through experimentation, inquiry, writing, dialogue, and questioning, that encourages collaboration and teachers working together."

In one of the meetings, I had with my supervisor and my critical friend, I was excited to tell them about the idea of the revival of the mathematics subject committee that I have started with my fellow mathematics teachers in my school. The feedback I received from my supervisor was, "now

you see how the link between the process of doing your study which has an impact on your practice and other teachers around you." This meeting has helped me realise that I started to implement and speak to some things that came out of this research. I concluded that if we as mathematics teachers could frequently meet, we could offer each other support and identify common problems that we face as mathematics teachers in different schools and can use the help and guidance of mathematics subject advisors. Similarly, Friedrich and McKinney (2010) affirm that teachers who work together and learn from each other are more successful in improving student outcomes than those who work alone.

Learning 2: Reimagining my enactment of the CAPS policy document for mathematics

Doing this self-study helped me understand and identify my role within the prescribed curriculum as a mathematics teacher. The Curriculum and Assessment Policy Statement (DOE, 2011) is a prescribed document for mathematics that provided me as an educator with an understanding of mathematics, specific aims, specific skills, focus of content areas, the weighting of content areas, and content specification. Before I engaged with this study, I could not see myself and my position other than following the policy document. It always felt like an obvious thing expected from teachers by the DBE, but now I know I can always find my way around it and make it fit into my context and fit my learners. It forced me to look at myself, my practice, and the enacted curriculum. This study helped me improve the way I teach, and I learned that I could use more teaching strategies to teach one topic, to reach learners at different levels instead of relying on one method from the textbook. Some of the techniques I learned are using various manipulatives to engage with the learners and bring life to lessons.

The study has also forced me to research innovative strategies to teach numbers, operations, and relationships, which awarded me the skill of integrating mathematics with technology. In 2016, ALPHA donated computer tablets to our school, but teachers were not using them in their lessons because most teachers were not computer literate. As elaborated in chapter four, my engagement with this study forced me to research integrating mathematics with technology (computers, tablets, and overhead projectors). I took it upon myself to educate myself on how to use these resources in my lessons properly through the help of YouTube and the Information Communication and Technology (ICT) specialists from our district offices.

Most children are fond of technology and are already interested in using technology gadgets such as computers and tablets. I researched more approaches from the internet on how to teach numbers operations and relationships best. In one of the lessons where I was planning a lesson on adding

and subtracting fractions, I found an interesting method called a butterfly method (elaborated in chapter four). I downloaded this method, then I let my learners watch it through the overhead projector, and I was amazed at how they quickly understood the concept. This experience taught me that when technology is integrated into lessons, learners become more proficient in subjects they are studying because they are provided with different opportunities to make learning more fun and enjoyable in teaching the same things in new ways. Figure 5.2 is the metaphoric image of re-imagining of the CAPS policy document for mathematics.

Figure 5.3 is the metaphoric image of re-imagining of the CAPS policy document for mathematics.

Learning 3: Seeing learner voice and participation as an asset in teaching and learning

Figure 5.4: A notepad and glasses represents researcher and learner journals

The selected image above from the collage (figure 5.2) represent what I learned through this self-study's methodology. Some of these learnings were formal lessons that I can use to develop my future teaching and learning. Some were informal learnings that can assist in my personal, educational journey as a teacher. The notepad with glasses represents both the researcher and learner's reflective journals used as some of my data sources. The learner's journal that learners wrote mostly after each lesson to express how they perceived the lesson, helped me reflect on my past and present experiences.

One of the learners wrote about my severe and intimidating face saying that she feels an intense level of discomfort accompanied by stupidity whenever I enter the class during the mathematics period. This feedback was the most hurtful thing I had to know about myself as I had always considered myself a friendly person. As elaborated in chapter three, I believe that the teacher I am today is mostly influenced by how I was taught and socialised. When I was still at school, the respectable teachers maintained strict discipline in their classes at all times. As much as I feared those teachers, I wished I could be just like them one day, but when I became a teacher, I never regarded myself as one of those teachers that learners feared. From this experience, I then decided to be friendly but not familiar with my learners. I kept reminding them that should they have any educational and personal problems, they must feel free to come to me. Hence, I rearranged the class to be more welcoming and conducive to the learners' needs (details and figures in chapter four).

The learner's reflections from the journals motivated me to find ways to make learners feel accepted and make the classroom friendly to support teaching and learning. I then revamped my grade seven mathematics classroom into a mathematics class that was inspiring to other mathematics teachers. I realised that the classroom's physical learning space is often overlooked when discussing critical aspects of learners' learning, in most cases. I learned that a well-structured classroom helps improve learners' academic and behavioural outcomes because an orderly classroom enables them to focus and assists in learning at hand and not being distracted by untidiness or chaos around them. The structure of the classroom should be one that allows instructional deliverance methods to be used. Therefore, how the classrooms are structured should support the use of and whole group instructions and provide independent practice. Spacing should exist to walk around the classroom to observe and conduct informal assessments and provide support and feedback. Learners learn best in a classroom with access to various resources to manipulate, experience and observe. When decorating the classroom, I used charts and miscellaneous learners' work to promote learning and positive behaviour.

Learning 4: Knowledge of learners – teachers' instruction tailored to meet each learner needs

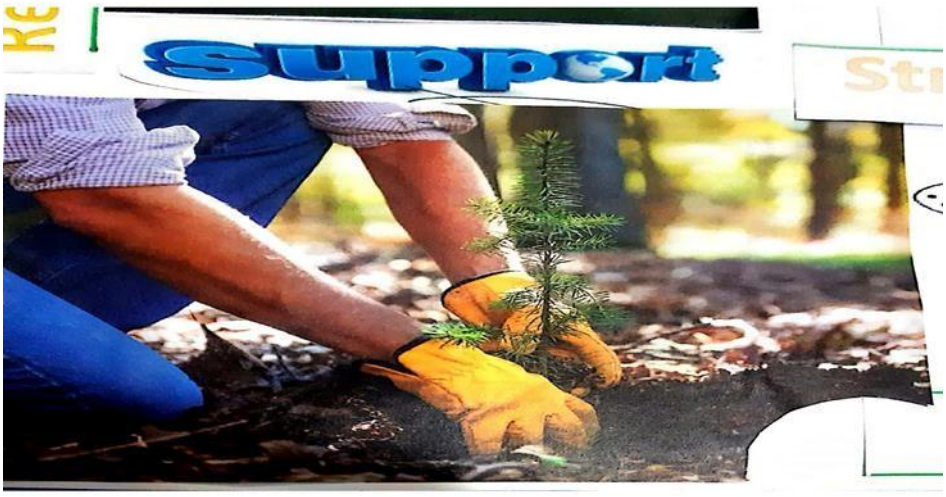


Figure 5.5 An image of a farmer representing the teacher attending to learners needs

The image of a farmer (figure 5.5) from the collage represents my role as a teacher in my learner's educational and personal lives. I have discovered that my role as a teacher is similar to the farmer who grows different fruit representing diverse learners. Different fruit need additional requirements to grow, and some require plenty of water, while some fruit need less water to grow.

Other fruit need direct sunlight, while some grow well in the shade. To have a good harvest, the farmer must understand and attend to each fruit's individual needs. Through this study, I know that as a teacher, I need to understand children's needs using different innovative strategies and methodologies to have successful teaching and learning take place and thereby produce good results. These new strategies and teaching methods are elaborated on in chapter four. I integrated a mathematics lesson on fractions with a baking lesson where learners applied fractions such as half, quarter, three quarters as they were baking the cookies.

Samaras (2011) maintains that self-study is designed to improve learning, Similarly, I used self-study as my research methodology, which helped me understand and develop myself and my practice as a teacher and understand my grade seven learners. To seek support and validation throughout my study journey, I have worked with my critical friend, who played a vital role in my developmental journey. I learned a lot from the discussions and meetings we had. She played a

crucial role in learning and understanding constructive criticism, which is part of professional and personal development.

Methodological learning

The self-study methodology gave me a chance to be able to critique my practice because it forced me to look at the true self of myself as a primary school mathematics teacher and seek solutions. Hamilton, Smith & Worthington (2008) argue that addressing oneself can help us understand teaching and teacher education. My critical friend and my grade seven learners as participants taught me to reflect and read other people's reflections towards my practice. It is through this self-study that I learned to have other people's perspectives on my practice. This study has helped me understand and identify my role as a teacher within the prescribed curriculum. In the past, I could not see myself and my position other than following the policy document as is. It always felt like an external thing that I was expected to do, but now I know I can always find my way around it and fit it into my context and my learners. It forced me to look at myself, my practice, and the enacted curriculum. This study helped me improve the way I teach; I learned that more teaching strategies requires the teacher to teach one topic to reach learners at different levels instead of relying on one method from the textbook. With some of the strategies, I learned the importance of using manipulatives in my teachings.

The study has also forced me to research innovative strategies to teach numbers, operations, and relationships, which awarded me with the skill of integrating mathematics with technology. In 2016, as shared in chapter four, a company called ALPHA donated tablets to our school, but teachers were not using them in their lessons because most teachers were not computer literate. My engagement with this study forced me to research integrating mathematics with technology (computers, tablets and overhead projectors). I took it upon myself use these resources in my lessons with the help of YouTube and the Information Communication and Technology (ICT) specialists from our district offices.

Conceptual and theoretical learning

In chapter one, I identified and elaborated on my key concepts that were central to my self-study research: *a) teacher learning b) enacted curriculum* and also discussed how my theoretical framework (RME) helped me understand these key concepts. I used the RME framework to structure and guide my lessons, which meant that as I was planning for my lessons using the curriculum, I needed to make sure that the concepts of numbers, operations, and relationships are taught realistically. Bertram (2011, p. 12) acknowledges that "teachers learn both by acquiring

knowledge and skills as individuals and by developing their competence in communities of practice." There are numerous skills that I have developed on this self-study journey. My engagement with this study made it possible to acquire e-learning skills, and I was able to initiate and fast track some workshops from the district offices.

Most children are fond of technology gadgets, including tablets. My teaching and learning helped me teach more realistically as I was able to tap into learner's interest in technology gadgets and capitalise on this interest. I was able to research the internet for more approaches to teach my topic more effectively, for instance, while I was teaching addition and subtraction of fractions, I found an interesting method called a butterfly method. I downloaded this method, then I let my learners watch it through an overhead projector, and I was amazed how quickly they understood the concept.

My contribution to the practice of teaching

Moving forward, I would like to pursue further research on the topic: teaching numbers, operations, and relationships and work collectively with my fellow mathematics educators to support professional development and improve teaching practice. I believe that the challenges we face in teaching mathematics in primary school cannot be solved if we continue to work in isolation. We need to work collectively to explore innovative methods of teaching numbers operations and relationships to address critical issues relating to the effective teaching and learning of mathematics in South African primary schools, particularly in those historically disadvantaged regions that still suffer most from lack of relevant learning performance and achievement.

Conclusion

My motivation for engaging in this self-study was inspired by my concern for poor performance in my grade seven mathematics class on numbers, operation, and relationships. I wanted to find different strategies to capture learners' attention in class and bring back the love of numbers in my class by finding other approaches that capture learners' attention while learning numbers, operations, and relationships. To successfully do this, I needed to develop my practice as a teacher, and engaging myself in this self-study has improved the teaching and learning in my class. This journey has taught me that numbers do not have to be taught in isolation; learners need to see numbers are part of their daily activities. For learners to fully understand and achieve excellent performance, class activities must be meaningful and realistic to learners.

Self-study also awarded me by looking at my personal history experiences to reflect on myself as a teacher and the influences that made me the teacher I am today. Therefore, I took to my class and used some of the good experiences that I felt useful and beneficial to my teaching and learning.

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UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

04 May 2018

Mrs Ntombifuthi Prisca Zondo (Mdabe) (204001829)
Scool of Education
Edgewood Campus

Dear Mrs Zondo,

Protocol reference number: HSS/0258/018M
Project Title: Teaching Number Operations and Number Relationships in a Grade 7 classroom: A self-study

Approval Notification – Expedited Application

In response to your application received 23 March 2018, 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

[redacted]
.....
Dr Shamila Naidoo (Deputy Chair)

/ms

Cc Supervisor: Dr Lungile Masinga
Cc Academic Leader Research: Dr SB Khoza
Cc School Administrator: Ms Tyzer Khumalo

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education

Department:
Education
PROVINCE OF KWAZULU-NATAL

Enquiries: Phindile Duma
Ref.:2/4/8/2015

Tel: 033 392 1063

Mrs NP Mdabe
55 Grassmere Drive
Nagina
3610

Dear Mrs Mdabe

PERMISSION TO CONDUCT RESEARCH IN THE KZN DoE INSTITUTIONS

Your application to conduct research entitled: **"TEACHING NUMBER OPERATIONS AND NUMBER RELATIONSHIPS IN GRADE 7 CLASSROOM: A SELF STUDY",** 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 30 September 2019 to 01 October 2022.
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 Phindile Duma 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.

UMlazi District

[redacted]

Dr. EV Nzama
Head of Department:
Education Date: 30 September 2019

Grassmere Drive

NAGINAH

3610

22 February 2018

Dear student

REQUEST FOR CONSENT TO USE FINDINGS FROM YOUR CONTRIBUTION IN……

Title of study:

Teaching Number Operations and Number Relationships in a Grade 7 Classroom: A Self-Study

The purpose of conducting this study is to improve my teaching practice to enhance and develop learners' calculation techniques**,** number concepts as well as advancement of number vocabulary in grade 7 learners.

This study is supervised by Dr Lungile Masinga who is a lecturer at the School of Education, UKZN. She can be contacted telephonically at 031- 2603439 or Masingal@ukzn.ac.za for further information.

The information will be generated through self-study. I will use hardcopies of your written work and journal entries you will keep during the research period. I therefore request your permission to refer to your contributions.

I will only use your work if you give me your consent. It will be used in a way that respects your dignity and privacy. Hard copies and journal entries of learner's work will be safely stored and discarded if no longer required for research purposes. Your name or any information that might identify you as a student will not be used in any presentation or publication that might come out of the study.

There are no direct benefits to you from participating from this research. I hope this study will make valuable contribution to the teaching of grade seven mathematics. I also wish to inform you that you do not have a legal obligation to have you participating in the study. You may withdraw at any point and that will not affect or put you at a disadvantage.

I hope my request will be considered positively.

Thanking you in advance

Prisca N Zondo (Mdabe)

INFORMED CONSENT DOCUMENT TO USE YOUR CONTRIBUTION TO RESEARCH

TITLE OF THE STUDY: Teaching Number Operations and Number Relationships in a Grade 7 Classroom: A Self-Study.

I, …… hereby confirm that I understand the content of this document and do give my consent to participate in the research that will be conducted during Mathematics lessons.

I also understand that my child can withdraw from the study with or without my permission and there won't be any negative or undesirable consequences to him/her.

Choose one by writing YES in the space provided:

I consent to the data collection activities of my (work) hard copies and journal entries

……

Or

I do not consent to the data collection activities of my (work) hard copies and journal Entries

Signature of Student Date

…… ……

20 February 2018

Dear Mrs Mdabe

PERMISSION TO CONDUCT RESEARCH AT NSIMBINI PRIMARY SCHOOL

This letter serves to confirm that Prisca Ntombifuthi Mdabe has been granted permission to permission to conduct research entitled 'Teaching Number Operations and Number Relationships in a Grade 7 Classroom: A Self-Study', in Nsimbini Primary School. The conditions of approval are as follows:

1. The researcher will make all the arrangements concerning the research.
2. The researcher must ensure that educators and learning programmes will not disturb the learning programme.
3. Learners, Educators and School are not identifiable in any way from the result of the research.
4. A copy of this letter is submitted to your Department Head (immediate supervisor).
5. Principal, educators and learners are not obliged to partake or assist you in your investigation.

I have no doubt that her findings and recommendations will benefit our learners and improve results in Grade 7

Yours Faithfully

Mr X

55 Grassmere Drive

NAGINAH

3610

20 February 2018 Dear

Critical friend

REQUEST FOR CONSENT TO USE FINDINGS FROM DISCUSSIONS IN CRITICAL FRIENDS MEETINGS.

Title: Teaching Number Operations and Number Relationships in a Grade 7 Classroom: A SelfStudy

The purpose of conducting this study is to improve my teaching practice to enhance and develop learners' calculation techniques**,** number concepts as well as advancement of number vocabulary in grade 7 learners.

This study is supervised by Dr Lungile Masinga who is a lecturer at the

School of Education, UKZN. She can be contacted telephonically at 031- 2603439 or Masingal@ukzn.ac.za for further information.

I hereby request your permission to use your valuable contributions during our critical friends' meetings and to avail yourself for meeting discussions. You will be notified in advance with the date and time for our meetings.

The discussions from these meetings will be recorded as data collection method.

If I receive your consent, I will use your contribution in a manner that respects your dignity and privacy. Your voice recordings and my notes of our discussions will be securely stored and discarded if no longer in use for my research purposes. You will not be identified even the name

of your school will not be used in any presentation or publications that might result out of this study.

There are no direct benefits to you from taking part in this study and that there is no legal obligation to the study, meaning you may withdraw at any time. There won't be any negative consequences or be prejudiced as a result of a consent withdrawal.

For further information on research participants' rights, you can contact Ms Phume Ximba at UKZN Humanities and Social Science Research Ethics Office on 031-260 3587.

Yours sincerely

Prisca N. Zondo (Mdabe)

INFORMED CONSENT DOCUMENT FOR PARTICIPANTS

TITLE OF THE STUDY: Teaching Number Operations and Number Relationships in a Grade 7 Classroom: A Self-Study.

I,…… hereby confirm that I understand the content of this document and the nature of the study.

I understand that I am free to withdraw at any time from the study without any negative consequences to myself.

Choose one of the following with a tick:

I consent to the data collection activities by attending meeting discussions and the use of my viewpoints and ideas in the study…….

Or

I do not consent to the data collection activities by attending meeting discussions and the use of my view points and ideas in the study…….

…… ……

SIGNATURE OF PARTICIPANT DATE

55 Grassmere Drive

NAGINAH

3610

22 February 2018

Dear Parent/Guardian

REQUEST FOR CONSENT TO USE FINDINGS FROM YOUR CHILD'S CONTRIBUTION IN……

Title of study: Teaching Number Operations and Number Relationships in a Grade 7 Classroom: A Self-Study

The purpose of conducting this study is to improve my teaching practice to enhance and develop learners' calculation techniques**,** number concepts as well as advancement of number vocabulary in grade 7 learners.

This study is supervised by Dr Lungile Masinga who is a lecturer at the School of Education, UKZN. She can be contacted telephonically at 031- 2603439 or Masingal@ukzn.ac.za for further information.

The information will be generated through self-study. I will use hardcopies of learners' written work and journal entries they will keep during the research period. I therefore request your permission to refer to your child's contributions.

I will only use your child's work if you give me your consent. It will be used in a way that respects your child's dignity and privacy. Hard copies and journal entries of learner's work will be safely stored and discarded if no longer required for research purposes. You child's name or any information that might identify him or her will not be used in any presentation or publication that might come out of the study.

There are no direct benefits to your child from participating from this research. I hope this study will make valuable contribution to the teaching of grade 7 Mathematics. I also wish to inform you that you do not have a legal obligation to have your child participating in the study. You may withdraw your child at any point and that will not affect or put your child at a disadvantage.

I hope my request will be considered positively.

Thanking you in advance

Prisca N Zondo (Mdabe)

INFORMED CONSENT DOCUMENT TO USE CHILD CONTRIBUTION TO RESEARCH

TITLE OF THE STUDY:

I, …… hereby confirm that I understand the content of this document and do give my consent for my child to participate in the research that will be conducted during English lessons.

I also understand that my child can withdraw from the study with or without my permission and there won't be any negative or undesirable consequences to him/her.

Choose one by writing YES in the space provided:

I consent to the data collection activities of my child's (work) hard copies and journal entries

……

Or

I do not consent to the data collection activities of my child's (work) hard copies and journal entries

…… ……

Signature of parent/Guardian Date

YN

Your name

Contact

Dr Anita Hiralaal

BA, HDE, B ED HONS, B COMM HONS, M ED, PH D

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Scottsville

Pietermaritzburg

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0825352777

Recipient Name

21 February 2021

Master's Thesis

TEACHING NUMBER OPERATIONS AND NUMBER

RELATIONSHIPS IN A GRADE 7 CLASSROOM: A SELF-STUDY

has been edited to ensure technically accurate and contextually appropriate use of language, grammar, logical coherency and presentation.

[redacted]

Dr Anita Hiralaal

M. Ed Dissertation

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