

TEACHING PATTERNS TO GRADE 2 LEARNERS

A TEACHER'S SELF-STUDY

BY

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COLLEGE OF HUMANITIES

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STATEMENT OF THE SUPERVISORS

This thesis is submitted with/without our approval.



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Dr Lungile Masinga



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Dr Makhosazana Shoba

ACRONYMS

AMESA	Association for Mathematics Education of South Africa
ANA	Annual National Assessments
BIBS	Biblical Studies
CAPS	Curriculum and Assessment Policy Statement
DBE	Department of Basic Education
DoE	Department of Education
MED	Master of Education
NCS	National Curriculum Statements
NCTM	National Council of Teachers of Mathematics
NEPA	National Education Policy Act
OBE	Outcome Based Education
SPTD	Senior Primary Teachers Diploma
USA	United States of America
ZPD	Zone of Proximal Development

ABSTRACT

The focus of my self-study was on improving my teaching of patterns in mathematics to grade two learners. My concern was that learners failed to complete, identify, create and describe patterns in mathematics. I therefore decided to examine my methods of teaching patterns in mathematics so that I could improve my practice and thereby enhance learners' understanding of patterns. I had to scrutinise my personal history of learning mathematics, patterns in particular, and explore how my experiences of learning patterns in mathematics may have had an impact on how I was teaching my learners. I employed social constructivism as a theoretical perspective to frame this study so that I could understand how people come to know and then channel my methods into assisting learners understand patterns. The participants in this study included me as the main participant, my grade two learners, and my critical friend who was also completing her master's degree qualification. My research was steered by two questions. The first question: *What can I learn from my personal history about my teaching and learning of patterns?* It helped me unearth the learnings I acquired from my journey through my past learning experiences and this changed my perception of effective teaching. The learnings I acquired from my personal history were: *creating a positive learning environment, employing practical-based learning, incorporating games into learning and teaching of patterns, and understanding parental involvement in learners' education.* The second question: *How can I improve my teaching of patterns to grade two learners?* In response to this question, I employed the learnings stated above to guide me when planning my lessons so that my teaching would then be different. I generated data using self-study methods such as collage, artefacts, drawings, audio-recordings and journal writing. A review of the literature on mathematics learning and teaching, emphasised using games and practical activities in order for learners to learn and understand in a fun way. This self-study research helped me understand that as teachers, we need to reflect on our teaching and engage in introspection to find answers within ourselves.

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CHAPTER ONE

BEGINNING MY JOURNEY OF SELF-STUDY

Introduction

I developed an interest in embarking on this self-study research because I wanted to improve my teaching so that I make learners understand patterns in mathematics and mathematics in general. Fleisch (2008) reveals that South African school children are under achieving in mathematics as a whole, with patterns as part of that whole. Similarly, Spaul (2013a) points out that 70% of learners from grade eight to grade twelve, do not meet the required standards in mathematics as set out in the curriculum. In South Africa and other countries, there is a lot of pressure on teachers to ensure that learners pass mathematics and this acts as a catalyst for teachers to think differently about the way they teach mathematics (Du Plooy & Long, 2013).

In this chapter, I provide background information about myself as a researcher and a teacher. I then explain the focus and purpose of my study from which I was able to glean the personal and professional reasons for doing this study. Furthermore, I touch on the literature review as well as the research questions for this study. Thereafter, I introduce the research methodology used in the study and I outline the theoretical lens through which I viewed this study. I end the chapter with a conclusion and an overview of the dissertation.

Background information

I am a teacher, teaching grade two learners at a school in a semi-rural area in the province of KwaZulu-Natal, South Africa. Learners at this school are isiZulu mother-tongue speakers but the school SGB opted for English as the medium of instruction from grade R to grade seven as stated in the South African Schools Act 84 of 1996 in the section called Language Policy (Department of Education, DoE, 1996). I studied as an intermediate/senior phase school teacher, which is teaching from grades four to nine. So initially, I taught in the intermediate phase. Mathematics was not one of my specialisation subjects and that is why I only studied the didactics of mathematics that prepared me with pedagogic content knowledge of mathematics. Pedagogic content knowledge capacitates you in the methods of teaching a certain subject (Wright, 2017). The subject content knowledge of mathematics, which I merely glanced over whilst studying the didactics of mathematics, was insufficient to equip me as a confident mathematics teacher.

When I first started teaching, my principal assigned me to teach mathematics, but I did not embrace this because of this lack of subject content knowledge. I did not feel confident to teach this subject and I think this feeling affected the way I approached the teaching of mathematics as well as the way learners felt about mathematics. I would drill counting and times table most of the time, not allowing them to explore their own to find the multiples of numbers which is the way I was also taught, see chapter 3. In addition, the pressures to treat mathematics as an important subject because of the dismal pass rate in mathematics in all grades, caused added anxiety to me as well as other South African teachers (Hlalele, 2014).

During my first year of teaching, I found that preparing for mathematics lessons as compared to other subjects, was a daunting task, since I had to first become familiar with the mathematics content before I could confidently teach it. As support to novice teachers of my time, the Department of Education (DOE) in South Africa, offered in-service courses of one to two weeks duration, on the content of mathematics. I found that these courses were not sufficient because they did not help with the day-to-day teaching of mathematics. The courses concentrated on content knowledge whereas most of the problems were pedagogical (Wright, 2017). Unfortunately, during my first year of teaching, the DOE ceased offering these courses because of curriculum changes. As the years went by I learned to use different kinds of sources to teach mathematics and that assisted me to gain and improve on my content knowledge for primary mathematics.

Additionally, I became a member of the Association for Mathematics Education of South Africa (AMESA). The association holds workshops and annual conferences which take place in different provinces each year. In the conference the majority of the content is covered and learned in these gatherings. However, I realised that learners continued to not do well in patterns, I then started to wonder and question the methods I used to teach patterns. Therefore, I needed to undertake this self-study with the hope that it might lead me to becoming self-reliant with regard to teaching mathematics efficiently.

After seventeen years of teaching grades four to seven, I moved to a new school where I was assigned, grade two teaching in the foundation phase, which is from grade R to grade three. It is clearly stated in section 3(4) of National Education Policy Act, Act no. 27 of 1996 RSA (2000) that, “in the case of foundation phase educators, the specialisation will be three learning

areas of the foundation phase as well as understanding of learners and learning...” (p. 12). This means that there is no specialisation and foundation phase teachers have to teach all subjects that make up the foundation phase curriculum. Mathematics was one of the subjects that I had to teach. Teaching in the foundation phase was an overwhelming experience in the beginning, because I was not used to teaching very young children. Even though my colleagues and my departmental head intervened and assisted me with some methods of teaching that were relevant to teach foundation phase learners, I felt it was not enough. This is another reason why I decided to undertake this self-study in order to explore how I was teaching these foundation phase learners and find better ways of teaching them.

In the foundation phase, the curriculum policy document, namely the Curriculum and Assessment Policy Statement (CAPS), the section on patterns is included in the content area called Patterns, Functions and Algebra (DoE, 2011). This policy document specifies that learners must be able to “identify, extend, describe, and create geometric as well as number patterns” (DoE 2011, p.24). I developed an interest in this topic after discovering that every time I analysed an assessment task, which was conducted quarterly, patterns were always one of the areas that needed my attention.

In my view, the high level of difficulty experienced by my learners lies in the description or generalisation of a pattern, which can be, either a language issue or lack of problem solving skills or both. I say this because some learners are able to identify the commonality of a pattern, that is revealed when they extend the pattern but fail to put it in words or give a rule to what they did to extend the pattern. Concurrently, Barwell (2003) affirms that learners who learn mathematics and are not mother-tongue English speakers, have more problems understanding mathematics than those who are mother-tongue English speakers. Since I am entrusted by the Department of Education (DoE) as specified in the CAPS policy document, “to enable learners to make predictions and solve problems” (DoE, 2011, p. 9), I found it necessary to do this self-study about the teaching of patterns, so that I can improve my practice and be able to teach learners how to reach the desired level of creative thinking and problem solving when they learn about patterns (DoE, 2011).

Focus, Purpose and Rationale

The main focus of this study is to improve my teaching of patterns to grade two learners by enhancing my methods of teaching and gaining more knowledge about patterns in mathematics.

My research took me back to my early involvement in patterning activities from the informal setting at home, to the formal learning experiences of patterns at school. The key was to draw from past experiences and both the positive and negative influence this experience might have had on my current practice.

Personal Motivation

Being a teacher who did not specialise in mathematics, I was motivated to introspect; with the aim of finding out if it caused me to lack some mathematics teaching methods especially the section on patterns in mathematics. As a result, I decided to do this self-study because I thought I was not enacting the curriculum, as I should, since learners could not demonstrate the expected outcomes as outlined in the CAPS document.

Considering that I was not confident in teaching mathematics, I found that I ignored some of the learners' expected outcomes such as creating their own patterns because I thought that they were too abstract for my learners since most of them could not even extend the given pattern. In some instances, I would write descriptions to match the given patterns to make it less difficult for them to describe patterns. As Kalder and Lesik (2011) explained in their research on teachers' attitudes toward mathematics, teachers who have low confidence in teaching mathematics, have low expectations of learners' achievement in mathematics. Hence, it was this attitude, caused by my own lack of confidence that needed some attention.

Additionally, the fact that I had recently started teaching the foundation phase learners was also a cause for concern. Learners in the foundation phase were either bored or misbehaving in the class. It could be that the pedagogical content knowledge for the intermediate and senior phases (grades seven to nine) that I possess, is different from the pedagogical content knowledge needed in the foundation phase (Balgalmis, Cakiroglu & Shafer, 2014). Hence, interesting ways to teach patterns to foundation phase learners, grade two in particular, also ignited my eagerness to do this research.

Professional Motivation

Apart from the personal reasons that propelled me to do this study, there are also external motives that I should recount. The Norms and Standards of Educators Act, which is section 3

(f and l) of National Education Policy Act no. 27 of 1996, stipulate the roles and competences which educators should be proficient in (Africa, 1998). Improving my methods of teaching patterns would be fulfilling one of my accountabilities expected in the above act. One of the required competencies of a teacher is that teachers should understand and interpret the given curriculum and thereafter design lessons suitable to deliver and fulfil the curriculum requirements (Africa, 1998). In addition, the curriculum requirements will not be met, if learners lack the competencies of identifying, extending, describing and creating patterns as stated in Curriculum and Assessment Policy Statements (Department of Education, DoE, 2011). Another competency that a teacher should have is to “apply research to educational problems” (Republic of South Africa, 2000, p. 20). This tells me that the DoE/Department of Basic Education (DBE) relies on us as teachers to do research which will bring positive changes to school education and this is a contributing factor to me undertaking this research study.

The CAPS document for grade 2 mathematics, mentions that the central requirement when teaching patterns, is for the learner to achieve efficient manipulative skills in the use of algebra (DoE, 2011). Thus, the curriculum expects me to plan for learners to focus on the logic of patterns which lays a foundation for developing algebraic thinking skills (DoE, 2011). I have learned from Ferrington (2018) that “pattern is a password to mathematics” (p. 4). Hence, my concern was raised by that notion and because I have realised that my learners are greatly challenged in using their thinking skills when describing patterns, and this could be the cause for future barriers to learning mathematics especially in high school, where explaining their thoughts and verbalising solution strategies are part and parcel of mathematics (Sitabkhan & Platas, 2018). As a consequence, I am doing this self-study.

The Annual National Assessment (ANA) (2013) Diagnostic report (Figure 1.1) shows that the section on patterns is amongst the sections that learners failed (DBE, 2013). The report in the excerpt below shows the analysis for the section on grade two patterns ANA results for 2013 and one example of a learner’s response on the pattern question. If learners fail to see the logic of how the pattern is created, they cannot extend the pattern. If they cannot extend the pattern, it means they do not understand the regularity in a pattern and it becomes even more difficult for them to describe the pattern (DoE, 2011). Figure 1.1 is an excerpt from Annual National Assessment 2013 Diagnostic Report.

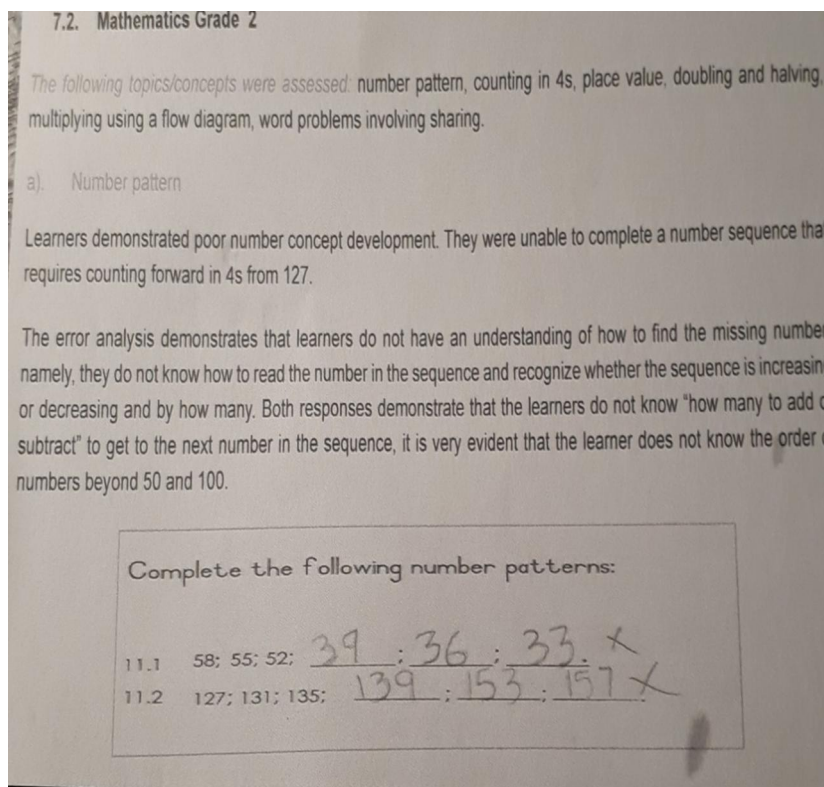
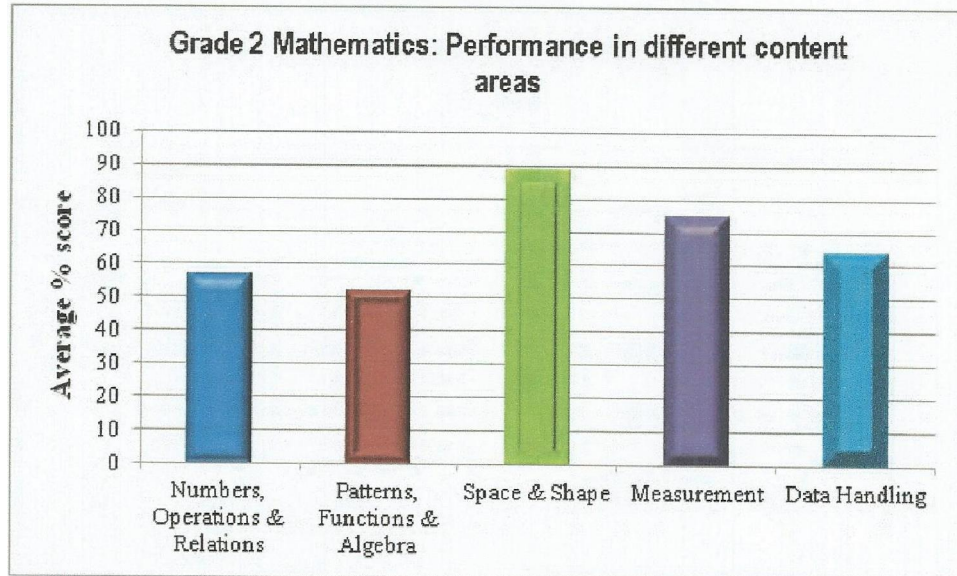


Figure 1.1 Excerpt from Annual National Assessment 2013 Diagnostic Report (p. 13)

The Education Department's intervention of providing ANA exemplars which foundation phase teachers could use for learners to practice with, prior to the actual writing of the 2013 ANA tests, did not work. Even the DBE (2014) Annual National Assessment 2014 report, revealed a very low pass percentage of mathematics for all grades especially in KwaZulu-Natal. Below is the graph (Figure 1.2) showing learners' performance in different content areas in mathematics for the 2014 Annual National Assessments.

Figure 5: Grade 2 learner performance in the various content areas



According to Figure 5, Grade 2 learners experienced the greatest difficulty in responding to questions on "Patterns, Functions and Algebra". The second area of marked difficulty as experienced by learners was "Number, Operations and

Figure 1.2 An excerpt taken from the Annual National Assessment 2014, Diagnostic Report

According to this graph –patterns, functions and algebra is still the most difficult content area in mathematics for grade two learners. It is evident that the DBE intervention for 2013 of giving learners ANA exemplars to practice with, was not efficacious especially with patterns. The lack of understanding patterns and number sequencing, was also exhibited in the following example (Figure 1.3)

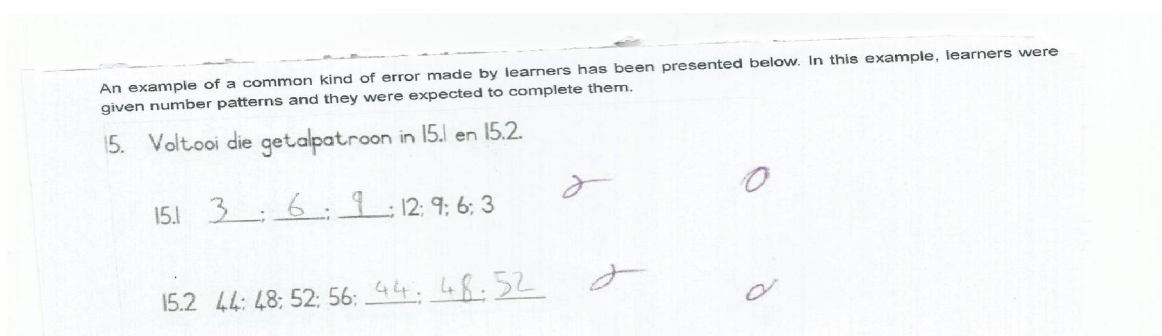


Figure 1.3 An example taken from the Diagnostic Report for 2014 Annual National Assessments

The learner in the above example could not count in multiples of three and four to complete the pattern. This shows that the learner was unable to understand the commonality in the number pattern before they attempted to complete the pattern and they seem unfamiliar with counting backwards (DBE, 2014). Five to six years later, the findings in my view still ring true as I continue to see learners struggle to understand this section. Doing this self-study is essential

to find new methods of teaching patterns and address the national problem experienced with mathematics and patterns in particular

After the discontinuation of Annual National Assessment (ANA), the National Integrated Assessment Framework (NIAF) became a replacement due to the constant criticism. NIAF aimed at assessing learners in a three-year cycle, concentrating on mathematics and reading in different languages in the primary schools (DBE, 2018). The first 2018-2020 cycle commenced, but according to DBE (2020) in the revised Annual Performance Plan, the delivery of NIAF was disturbed and weakened by the pandemic COVID-19, which affected and still affecting education and curriculum stability.

Introductory Literature

This introductory literature review is a summary of some of researchers' work on the teaching of patterns in mathematics. It is important to note in this study that there is no chapter for a literature review because "references to texts are integrated into the story line of the self-study research text" (Pithouse, 2007, p. 22).

The CAPS document defines mathematics "as a language that uses symbols and notations to describe numerical, geometrical and graphical relationships" (DoE, 2011, p. 3). I believe that patterns, in mathematics, cannot be distinguished by primary school learners because with patterns, we deal with many concepts of mathematics such as manipulation and sequencing of numbers, geometry and graphs. To emphasise my point, I draw from Zazkis and Liljedahl (2002) who postulate that patterns are the heart and soul of mathematics.

According to Jennison and Beswick (2010), patterns are the foundation of algebraic thinking. Based on the statement above, I feel that as a primary school teacher, I have to do enough to prepare learners for a smooth transition from arithmetic patterns to algebraic thinking, therefore I have to use enough participatory learning methods where they freely express their thinking. In agreement is du Plessis (2018), who accentuates that "the potential presented by patterns with cyclical structure to enhance algebraic habits of mind, through focusing on the structural aspects embedded in patterns, remains largely unexplored in South African primary schools" (p. 1).

During my schooling years, we lacked this foundation of algebra because as much as we learned some number sequences in primary school, they were not necessarily linked to algebra therefore I regarded algebra as a new abstract component of mathematics which dealt with lots

of problem solving. Beswick and Goos (2018) raise a point that teachers' lack of in-depth knowledge of algebraic thinking in the primary school, might be the cause for the mathematics setbacks in high school learners. Moreover, different writers regard algebra as one of the learning areas of mathematics, which is generally difficult for high school children (Beswick & Goos, 2018; du Plessis, 2018; Yildiza & Akyüz, 2019).

Concurrently, Ilyas et al (2013), claim that it is very important for learners to understand patterns and structure in the early years so that they get the foundational knowledge of algebra. Additionally, Fraenkel, Wallen and Hyun (1993) believe that, students who have acquired understanding of patterns well in primary school are expected to excel in solving lower order algebraic problems in high school. It is also worth noting that teaching patterns in isolation, may exacerbate challenges already associated with the teaching of algebra for learners doing mathematics in high schools.

Since it is foregrounded above, that the stumbling block lies in learners' lack of understanding patterns, I felt I had to reflect on my methods of teaching patterns. Reflecting on my methods would oblige me to seek knowledge on how I can plan activities that allow learners to predict and prove a logical connection in a pattern. Most of the readings I came across for this research study, put emphasis on engaging learners in activities while they interact with each other and letting them play games is the best methods of ensuring that they understand patterns (Sitabkhan & Platas, 2018; Thouless & Gifford, 2016; Wilkie, 2014; Yildiza & Akyüz, 2019).

Additionally, for learners to understand patterns, I should link activities of teaching patterns with real life experiences (Skwarchuk, 2009). I have realised that I should let them know that patterns are all around them by allowing them to identify patterns even in other subjects. Patterns are also found in Art, Music, Technology and Languages (An, Capraro & Tillman, 2013), so I have a duty to make learners realise that the patterns they learn in mathematics are same as the logic they see in everything around them. For example, a sequence of decorative drawings in an art piece can display a certain pattern or the rhythm in a song and the rhyme in a poem can form part of patterns they learn in mathematics. Therefore, as Hlalele (2014) posits, I should use real life experiences to teach patterns so that learners will learn to think logically and creatively while solving real-life problems in the long run.

For this research study, I chose self-study as a research methodology and as a wheel for my professional development. Samaras et al (2019), agree that self-study is about examining

oneself, for the purpose of improving one's practice. Furthermore, Pithouse et al (2016) concur that the transformation starts with the self and then others.

Research Questions

This study is guided by the following questions:

What can I learn from my personal history about learning and teaching of patterns?

In chapter three, I give details of how I responded to this question. Through this question, I reflect on my past experiences, of my early engagement with patterns. I draw from how I learnt patterns informally at home when we were doing household and garden chores and then at school when we concentrated on numbers. To write my personal history I use research tools such as collage making, narratives, drawings, audio-recordings and artefacts, I highlight positive and negative memories, which I draw learnings from, that may assist me in improving my teaching of patterns.

How can I improve my teaching of patterns to grade two learners?

I engage deeply with this question in chapter four of this study. I draw from my experiences that are highlighted in chapter three to see if they have had an impact on my improvement of teaching patterns. I show how my learnings from chapter three helped me plan lessons on patterns, differently, using methods that are more learner-centred. I consider learners' feelings when I teach them and I also focus on what interests them. I illuminate how I interacted with the learners during the lesson. I watched them play pattern games such as hopscotch and word puzzle and I recorded their actions as they identified and described patterns by themselves.

I reflected on the learners' work and recorded my journal reflections, on what went well and not so well with each lesson presented. I gave details on how I planned to make amends and improvements based on the reflections. I also noted how learners became comfortable in working in collaboration with each other as how they showed more respect towards each other during the lessons and learned from each other in their groups much better than they learned from me.

Methodological approach

This is a self-study and it falls under a qualitative body of work. Creswell and Miller (2000) claim that a qualitative approach seeks to understand a research problem as perceived by the local society it involves. In the case of this research, I seek to improve my teaching of patterns. Creswell (2009) further asserts that “qualitative research is a means for exploring and understanding the meaning that individuals or groups ascribe to a social or human problem” (p.4). I therefore used qualitative methods in this study, to look at my personal history and to interpret data collected during contact with my learners.

Self-study of educational practice, begins with the teacher asking questions about their own practice and taking action in gaining competence and confidence in attempts to improve learners’ learning (Samaras, 2010). Additionally, Attard (2017) utters that reflection is the central part of teaching that every practitioner should do. This means that as teachers and or practitioners, we look back at our actions to check if what we did was right and to correct our own wrongs in the field of teaching. Moreover, Samaras (2011, p. 43) reveals ‘*personal situated inquiry*’ as one of the methodological components of self-study, so in my understanding this journey starts with me investigating myself about my practice of teaching patterns.

LaBoskey (2004, p. 820) asserts that self-study research is “*improvement-aimed*” and “*self-transformative*.” Self-study is different from other research studies because at the end of the study, there must be improvement of the researcher. LaBoskey (2004) further declares that self-study uses multiple methods of collecting data such as personal journals, lesson plans, and personal history that are used to improve the researcher’s practice. Pithouse, Mitchell, and Weber (2009) concur when they describe self-study as a general approach that uses a collection of methods. Hence, I used different methods to help me learn from my personal history and to generate data.

Collaboration as Samaras et al. (2019) stresses, is the wheel of self-study. Working with my critical friend, even virtually, is of utmost importance because she helped me to see things in different ways (Sharkey & Peercy, 2018). Collaboration is even emphasised when I generate data. Collaboration brought about improvement in the way I teach as well as in understanding the learners.

Insight into my learning through the social constructivist theory

This study is about teaching of patterns and the key focus area for this research is on finding better ways of teaching patterns in mathematics. Tanisli and Ozdas (2009) define patterns as a combination of shapes, sounds, symbols, actions and numbers. In my understanding then, patterns are an essential part of the mathematical development in young learners and therefore should be taught very well. The National Council of Teachers of Mathematics NCTM, (2000) asserts that a pattern is a vital process for the formation of generalising and generalising in turn is a basic structure of algebra. This means that, patterns are an important link between primary and high school mathematics. Since algebra is taught in high schools, finding the right approaches to teach patterns could help me help learners.

One of the general aims of teaching as emphasised in the CAPS document, is to produce learners that are able to identify and solve problems using critical thinking to make decisions (DoE, 2011). The curriculum does not clearly explain the methods of doing that. Hence, I have searched for a theoretical perspective that could help me with methods of teaching patterns effectively. The theory I have chosen is the social constructivist theory. Vygotsky (1978) and Piaget (1962) believe that construction of knowledge takes place when an individual finds an idea through his own efforts. Vygotsky (1978) further professes that cognitive development is produced during social interaction first and later in the individual mind. Through social constructivism, I have realised that the learning of mathematics does not happen if I only transfer knowledge to the learners (Armstrong, 2019). This encouraged me to create social groups within which learners will socialise during the process of knowledge acquisition (Vygotsky & Cole, 2018). Ernest (1996) concurs that social constructivism is about shared experiences of physical reality.

So, I planned lessons using physical objects for learners to interact with and make meaning of the patterns. In my understanding, social constructivism is more a learner-centered than teacher-centred theory. It reminded me that my teaching should move away from imparting knowledge to learners to interacting more with learners. Taylor (1990) argues, "...many social constructivist teachers find ways to structure activities so that they often function as a guide, not a sage on a stage" (p. 17). This idea is also supported by Von Glasersfeld (1995) and Mishra (2014) as they emphasise that social constructivism is a theory of learning not a theory of teaching. I, therefore understand that it is about how I plan for learning to take place, what learners will do and how I facilitate their learning.

Furthermore, one of the roles of educators as stipulated in the Norms and Standards for Educators under the National Education Policy Act 27 of 1996 Africa, (1998, p. 13), is that the teacher should be a “*mediator of learning, interpreter and designer of learning programmes and materials and a leader.*” Reading about social constructivism has helped me unpack this role because I now know that it talks about me making it possible for learners to participate in making their own meaning of what they are learning through collaboration with each other. Understanding the relationship between the knowledge and the knower and how learners get to know something will help me to plan for problem-solving activities that inspire learners to think (Lincoln & Guba, 2013).

Through social constructivism, I was able to understand that I should not limit learners to simple tasks as mentioned in my personal motivation, but to expose them to difficult tasks and let them practice creative thinking. Understanding Vygotsky’s Zone of Proximal Development (ZPD) will assist me plan activities that are not easy as they do not encourage learners to think, but to plan activities that are challenging and be there to facilitate and help the learners find meaning by themselves (Taber, 2011).

Conclusion and overview of the dissertation

I commenced this Chapter One, by revealing the focus and purpose of my study. I explained the skills and outcomes on patterns as stipulated in the CAPS document and highlighted how learners fail to grasp these skills. I then went on to give reasons that motivated me to undertake this self- study based on my belief that if learners understand patterns well, they can easily tackle any other concept of mathematics. In addition, I introduced and explained my two research questions. Having done that, I discussed the social constructivist theory I adopted as the theoretical lens through which I intended viewing my study and I introduced the methodological approach selected for my study.

In Chapter Two, I discuss the self-study research process. I start by explaining why I decided to choose a self-study methodology. I then go on to discuss the location and context of my study and describe my participants. I describe the research methods used during data generation and explain how I will use them in my study. I touch on the data analysis and interpretation. I describe how I tried to establish trustworthiness for my study. To conclude, I explain the challenges that I encountered during my study and how I overcame them.

In Chapter Three, I begin by creating a collage displaying pictures of my memories as a learner and a growing child. I use pictures from my collage and artefacts to illustrate my personal history. My memory collage helps me recall my early life experiences from home to primary school and high school that also, extends to tertiary education and to the work field. Using memory stories and pictures, I emphasise how the home, school, and community contributed to the way I always felt about mathematics. I also present the games I used to play with my friends before I started school, when we went to the river to fetch water and when I started primary school. I explain how they relate to patterns and how they represent the informal education that I received outside the classroom. I also use memory drawing to illustrate my personal life history in instances where I could not find pictures. In this chapter, I tackle my first research question: *What can I learn from my personal history about teaching of patterns?* I do this by analysing the learning themes that emerged from chapter three: *creating positive learning environment for learners, employing practical based learning, understanding parental involvement in learners' education, and incorporating games into learning patterns.*

In Chapter Four, I respond to my second question: *How can I improve my teaching of patterns to grade two learners?* I highlight how I respond to the question by planning lessons, using new methods of teaching my learners that are learner-centered, taking into consideration the theory of social constructivism. I present data generated during the lesson presentations. I describe how the lesson progressed, giving details of what took place as learners were engaged in learning activities using examples of learner journals as well as worksheets. As a way of displaying the improvement in the understanding of patterns in mathematics, learners created their pattern collage using pictures they collected. They identify the patterns in the pictures and they describe them by means of attributes such as colour, size, shape etc. Social constructivism is exhibited as they construct new knowledge based on what they already know.

Chapter Five is the concluding chapter of this dissertation. I present the collage to analyse the learnings I acquired through engaging in this research. I also draw on what I learned personally and professionally about patterns knowledge and pedagogic content knowledge and the self-study methodology. I explain how the study has helped me respond to my research questions. I highlight the important changes that the study has brought to the way I teach, not only patterns but mathematics generally and all other subjects. Finally, I explain how I plan to move forward with the teaching of patterns. I highlight the new improvements that need to be applied in future.

CHAPTER TWO

MY SELF-STUDY RESEARCH PROCESS

Introduction

My aim for this self-study was to explore new teaching strategies of teaching patterns that would work and make learners understand patterns in mathematics. When I visited my learning experiences as a young learner, I wanted to place myself in learners' shoes so that I could understand how they felt about some of the methods of teaching I used and about how I treated them as learners. The main reason for this was to generate and analyse data and use it to improve the way I teach patterns in mathematics and thereby improve learners' understanding of patterns in mathematics.

In chapter one, I explained the focus and purpose of this study. I then discussed the background information followed by my personal and professional reasons for undertaking this study. I then discussed the two research questions that were relevant to this study. Then, a brief overview was given, of the literature used in this study. This was, followed by an introduction to the methodological approach adopted in this study and I revealed the theoretical framework that guided me in this research. I ended the chapter by giving an overview of the thesis.

In chapter two, I discuss at length, my choice of the methodological approach I used in this research study. I begin by defining self-study methodology and then go on to give reasons why I think this methodology was relevant for my study. I describe the context where my study took place and talk about my participants while giving an account of the methods I used to generate and analyse data. Next, I deal with the issue of how I tried to establish trustworthiness for my study and finally, I explain how I tackle the challenges I experienced during the study and my attempts at overcoming these challenges.

Self-study research methodology

The methodological approach that I used for this study was self-study of practice. Self-study persuaded me as the researcher to examine my own practice through personal history. Critique from my critical friends and colleagues assisting me to learn more about my professional practice and improve my practice (Samaras & Roberts, 2011; Samaras, et al., 2019). In concurrence with Dhlula-Moruri et al (2017), my self-study research focused on an exploration of my professional learning of teaching patterns in mathematics and finding new teaching

strategies in collaboration with my critical friends that improved my teaching of patterns. As indicated in chapter one, I was concerned by learner's failure to meet the given criteria on patterns and self-study helped me to investigate my practice, find my weaknesses and work on improving my practice so that learners' understanding of patterns could improve.

Pithouse, Mitchell and Weber (2009) define self-study as research that comes with emotions, beliefs and interpretations and they further advise that the self in the self-study, must be considered, in relation to others. This means that when doing the self-study, I must be mindful of learners' and their reactions, so that I can improve the way I interact with them. As a self-study researcher, I have to invite my learners, colleague and my critical friends to critique my practice and give me honest and productive feedback (Knowles, 2014). Pithouse et al (2009) warn that as a self-study researcher, I have to be more self-conscious and be able to acknowledge my weaknesses and accept the possibility that I have not been teaching as I should. In this self-study, I look deeply at my teaching ideas and my actions in relation to learners, to discover who I am and how I am teaching (Pinnegar & Hamilton, 2009).

Furthermore, LaBoskey (2004) cautions that self-study researchers should understand that self-study is not about 'self-praising' writing, but it is about finding my strengths and weaknesses from my practice and using them to improve my practice. In addition, Peercy and Troyan (2017) believe in the 'practice to theory approach' which implies that teachers learn to teach after they have been engaged in teaching as they investigate the way they have been teaching in order to improve. In this research, I scrutinise my teaching of patterns and come up with the theory I have learned from my teaching practice in the form of data analysis (see chapter four and five). As a more experienced teacher, self-study will help me express the theory of my practice which for a long time I did not care to know (Dinkelman, 2003). In this research, I was assisted to "discover a shift from the focus of changing students' actions to changing [my] own" (Samaras et al., 2019, p. 201)

By choosing self-study methodology, I wanted to examine my own teaching in order to improve my practice and then enhance the learning of my learners. Loughran and Russell (2000) claim that self-study ensures the existence of the relationship between learning and teaching. This means that as I teach, I reflect on my practice and I gain knowledge about learners' behaviour and the reactions they exhibit when they understand and when they do not understand. Pinnegar and Hamilton (2009) posit that the kind of knowledge that one learns while being a self-study teacher, is from within the teacher and it is different from the one that

was imposed on the teacher at college. The pedagogical knowledge I learned while engaged in self-study is more vital compared to the pedagogical knowledge I learned at college because it includes care. I am the one who is discovering it, and it is more practical (Samaras and Roberts, 2011). Furthermore, Bullough et al (2001) concur that self-study closes a gap between theory and practice. The content knowledge I have, might not help me if I fail to transfer it to learners.

Pinnegar and Hamilton (2009) postulate that the aim of self-study is to throw light on and to stimulate the self rather than identifying and doing nothing. As a self-study researcher, I expect positive results of my practice from this study. Additionally, LaBoskey (2004) concurs that self-study is about taking responsibility and modifying one's own practice. Consequently, my study does not end at finding out why my learners fail to understand patterns, but it goes as far as looking at what went wrong and what I must do to change the situation. Self-study employs creative approaches such as personal history, whereby as a researcher I became an author (see chapter 3) of creative writing about myself from my early years to my teaching years (Mitchell, Pithouse, & Moletsane, 2009). The writing gave meaning to my development as a self-study researcher and helped me look at myself as a teacher through my learners' eyes. The main purpose of this study was to improve my practice as LaBoskey (2004 p. 802) states that it is 'improvement-aimed'.

My Research Context

My study took place at a primary school where I teach, in King Cetshwayo district, formerly known as Uthungulu. It falls under Umhlathuze circuit near Empangeni in the province of KwaZulu-Natal in South Africa. The school is located in a semi-rural settlement, which means it is not entirely rural or urban. Geographically, the school is close to a small town but most learners come from the rural settlements and come to the school by buses and taxis. It is not a multi-racial school, like other schools that are close to town, only black learners who speak isiZulu at their homes, attend this school. The language of instruction used is English even in the foundation phase including Grade R even though it is not their mother tongue.

As mentioned in chapter one, when parents developed the language policy for the school, as permitted by South African School Act 84 of 1996, DoE (1996), they chose English as the medium of instruction because they believed that it would be of benefit to learners when they start the intermediate phase. The school was granted permission by the Department of Basic Education (DBE) after the school made an application to use English as medium of instruction. From then on, the school received the correct workbooks and examination papers for the

Annual National Assessments (ANA) and other external tasks. Most of the learners' parents are not able to assist their children with their learning, either because they do not stay with their children or they are illiterate/ partially illiterate (unable to read and write), especially parents of learners who come from the rural areas. This causes problems with homework, which is usually not done by some learners, which suggests to me that I must look closely at the type of homework I give to learners.

The school is a state school with an enrolment of 1315 learners and 25 teachers. Most learners come from poor backgrounds and families with single parents who live on social grants. Overcrowding and poor infrastructure, which means lack of classroom buildings and dilapidated physical resources such as school grounds, offices and library are the school's common problems. The school is not only under-resourced in terms of capacity and infrastructure but it lacks learning equipment, teaching materials and human resources including teachers.

Participants

I am the primary participant in the study because it is a self-study. As I delved into my personal life history to recapture the experiences of both formal and informal patterns of learning, I followed the advice of Pithouse, Mitchell and Moletsane (2009) who assert that, although the research is named self-study, it must involve other people. Hence, my grade two learners comprising of 31 boys and 34 girls participated in the study. I worked with the entire class as it was my enacted curriculum that was under scrutiny as I was teaching patterns in grade two. My critical friend was a vital component of my participants, details of whom are given in the next section.

Critical friends

According to Tidwell and Jónsdóttir (2020), critical friends are people one works with on the self-study journey who interact with one other and the researcher to help clarify and analyse data. Hiralaal, Matebane and Pithouse-Morgan (2018) describe critical friends' contribution as "point of intersection where questions and ideas posed by critical friends seemed to make visible connecting lines and new directions" (p. 293). When I started this journey of self-study, I worked with three Master of Education (MEd) students who were also doing a self-study like myself. At the beginning of the research study, my supervisor and my co-supervisor met with

us every Thursday. Two of my critical friends were supervised by my co-supervisor while the other student and I were supervised by my main supervisor.

The four of us became critical friends for each other. I learned a lot from the debates we had when we were trying to understand what self-study is and how it is different from other types of research methodologies used by other students. During the first presentation which dealt with self-study methods such as personal journal, artefacts and lesson plans, my critical friends helped me understand that I needed to cite every source that I had consulted and this was most helpful because I was not doing that. Three of us taught at primary schools while the other taught at a high school. Unfortunately, two of my critical friends had to put their study on hold. The journey continued with the remaining critical friend, Miss K. She is a teacher at a primary school not far from mine. She teaches grade 4 but had taught grades two and three for many years before she was promoted to become a departmental head in a nearby school.

My critical friend acted as my mentor and she assisted me by giving alternative perspectives throughout my study (Farrant, 2014). In our meetings I used my cellphone sound recording app to record the conversations. It helped me when I made notes afterwards and it was always there replay in-case I forgot something.

I let her read the lesson plan of my presentation to my learners and she would advise me on how to better engage my learners in the lesson (Samaras & Roberts, 2011). For example, she told me to engage learners even during the introduction of my lesson so, as to arouse their interest the moment I started to teach (see lesson two in chapter four). This sharing of ideas with Miss K made my research journey less frustrating, as suggested by Samaras et al (2019), that sharing of ideas with critical friends stimulates new ideas. I found this suggestion most beneficial as many of my questions were answered and areas of confusion cleared because of my interaction with my critical friend.

As I presented the summary of my personal life history, using collage, my critical friend asked me challenging questions for example, she asked me how a certain picture is related to my topic, which led me to understand that my story should link with my study (Schuck & Russell, 2005). Nilsson (2010) suggests that as a critical friend, one also learns a lot while contributing to the other critical friend. When Miss K asked me to proof-read her lesson plan, I realised that she was not giving details of every single activity, which made me think about my own lesson plan. I thought of how I could avoid the same mistakes (Loughran, 2004). Our collaboration made me realise that when people work together, they become critical thinkers and problem

solvers. This then complemented my theory of social constructivism (as presented in chapter one) which stresses the importance of collaboration in order to learn better (Armstrong, 2019). The assistance I got from my critical friend was meaningful because she knew my study, so her assistance was not only based on my practice but on linking the theory I provided with my current practice and this reminded me to always ensure my study was intertwined with the literature I cited.

Data Generation Instruments

Self-study research has multiple data generation methods (Mena & Russell, 2017). I generated data using artefacts, collage, drawing, lesson plans, curriculum policy, journals and audio-recordings. To retrieve memories from my personal history, I used collage, drawings, metaphor and artefacts to attend to my first research question. Collage, lesson plans, curriculum policy, and journals, were used to generate data in the classroom and to respond to the second research question (see chapter one). Below is a table illustrating the data generation methods I used and the data sources in response to my research questions (Table 2.1)

Table 2.1 Data generation methods and data sources to address my research questions

Research questions	Data generation methods	Data sources
What can I learn from my personal history about learning and teaching of patterns? (chapter 3)	Presenting a collage summarizing my life history Writing a narrative personal history Collecting objects to help me recall my personal life history regarding learning of patterns and pattern related mathematics	Collage Memory writing and drawings Artefacts, Collage
How can I improve my teaching of patterns to grade two learners	-Writing a journal entry thinking about how to bring about changes in my teaching	Personal Journal

	-Learners draw the emoticons and write how they felt about the lesson Doing lesson plans using curriculum policy -Learners working in groups to make a collage of patterns and attributes Recording conversation between my critical friend and me	Learner journal Caps document & lesson plans -Collage Audio-recordings
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My personal journal

The personal journal is writing that involves different feelings and opinions about one's past and present teaching experiences (Samaras, 2011). Soon after learning about keeping a journal, I created a small notebook and entered my thoughts about my self-study but I soon realised that it was going to be too small, so I replaced it with a bigger exercise book. Even during data collection, I used my personal journal to write down daily events based on classroom experiences. I wrote about how I felt after a lesson and reflected on my observations of how I interacted with learners during the lesson.

Fulwiler (1982) posits that a personal journal is seen as a space that allows free writing or expressions without being confined into structure or format. So, in writing my entries in the journal, I wrote as I pleased because I was the only one who was going to read my journal and it saved me time. Similarly, Mitchell et al. (2009) concur by emphasising that a personal journal is written informally without fear of being judged which helps teachers to improve and reflect on their practice. Through my personal journal, I was able to engage in introspection and reflect on my teaching, which later helped me improve my practice. Below is my first journal entry in a small notebook that I had initially kept as my personal journal (Figure 2.1).

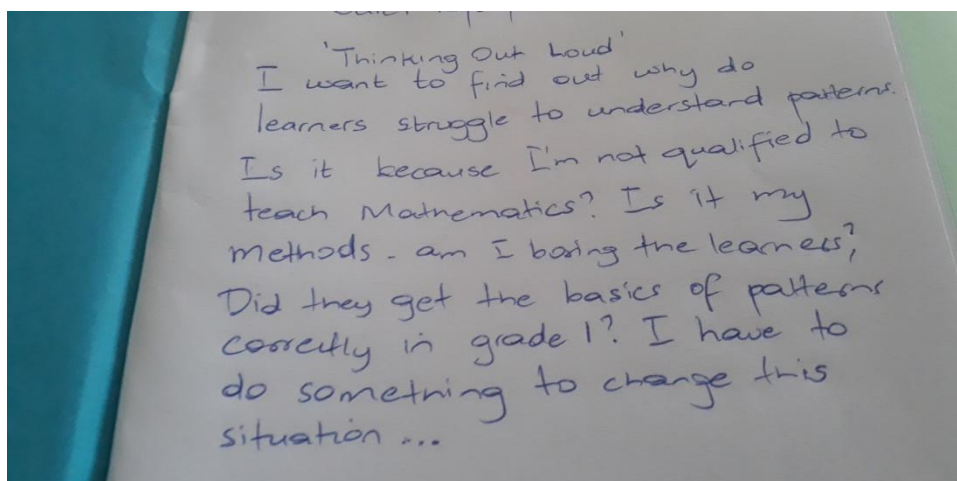


Figure: 2. 1 My first entry in my personal journal

Learner Journal

Learners also kept their journals. According to Fulwiler (1982), learners keep journals in which they say how they felt about the lesson and how the lesson affected their learning. I used learner journals to reflect on my lessons so that I could make sense of my improvement on practice. Loughran and Northfield (1998), assert that a self-study researcher does not do the research alone but they need information about the feelings of learners as participants. The learner journals also formed part of how I interacted with my learners as they showed me how they felt about the lesson using emoticons and sometimes, short descriptions of how they felt about the lesson (Samaras & Robert, 2011). Since my learners were participants, they had a say in my study and for my study to be a success, I had to find out how they felt about my practice. This is supported by Ilyas et al (2013) who claims that the methods of teaching that the teacher uses, has a negative or positive impact on the learners' learning that affects the way learners feel about the lesson.

Learners were, given a chance to say how they felt about the lesson and whether they understood the lesson or not. For many of them, writing descriptions in a journal by themselves was impossible because they were very young so I prepared booklets for them. I used emoticons/ smileys with descriptions. I gave them different images of emoticons or smileys and they had to choose the one that described their feelings about the lesson. There were some instances where they expressed in written words how they felt about the lesson. In chapter 4, some of the examples of learner journals are included. These journals also helped in the validation of my study. The journals taught me that learners enjoyed lessons when they were involved from the beginning and when games were part of the lesson as shown in chapter four.

Using photographs as artefacts

Trigger (1989) defines artefacts as the remains of an object or image that serve as the evidence of what happened long ago. In chapter three, on visiting my personal history, I collected different old photographs that reminded me of the things that happened a long time ago. These photographs elicited different emotions as some made me laugh while others made me sad as Samaras (2011) said they would. Moreover, Pithouse-Morgan and van Laren (2012), affirm that artefacts are objects with a cultural and historical significance. When I wrote my personal history, I had to choose photographs that were more significant and that gave me a better understanding of my younger self in relation to my topic. These photographs have some significance because they relate to my personal history and my learning of mathematics.

Photographs are used to revive our memories and to enhance our current practice (Masinga et al., 2016). The most significant photograph I chose was the photograph of my father who happened to be the icon behind my education. It brought me mixed emotions. I was sad because he passed on too early before I was able to take care of him financially but I was also very proud of him for paving a better future for my siblings and me against all odds. I also used a photograph of myself as a learner in grade 11 (Figure 3.7), which was significant to my study because it was taken at a laboratory at school where there was no science teacher. All these artefacts have significance for me because they brought more meaning to my personal history as highlighted by Madondo (2014).

Curriculum Policy

Curriculum is an official statement of what learners should know and are able to do at different age levels and grades in education. The current curriculum policy that is prescribed in South Africa is called the Curriculum and Assessment Policy Statements (CAPS). The CAPS document outlines the goals, vision and content that should be taught to different grades for different subjects. As Khoza (2015) advises, I must ensure that I know and understand the policy before I implement it. Being a self-study researcher, I wanted to find a deeper understanding of the content and my practice (Pinnegar and Hamilton, 2009). I therefore, used the CAPS document when I created lesson plans and activities. The curriculum in place prescribes the content and skills that I must teach under patterns such as identifying and describing patterns. Shoba (2009) emphasises the importance of understanding new curriculum policies as teachers and school managers, so that we enact it correctly to learners. Furthermore,

the Department of Education (DoE) trusts us to find a way of enacting the curriculum that helps learners acquire the relevant skills and content as stated in the CAPS document. This self-study has aroused me to reflect on my practice and helped me to ensure the curriculum policy is implemented effectively.

Lesson Planning

A lesson plan is defined by Womack et al (2015) as written preparation of how the lesson is going to be delivered, the activities to be done by the teacher and the learners, the methods and the assessment to be administered. Lesson planning is very important since that is where the teacher works around the topic, organising how to teach it (Wiske, Rennebohm Franz, & Breit, 2005). My starting point in lesson planning was to think about the concepts, skills and outcomes for each topic to teach. The next step was to think about the activities that would lead learners into achieving the outcomes. When planning the activities, I made sure that learners were actively involved in a lesson so that they enjoyed and understood the lesson (Wright, 2017). I planned activities where learners play indigenous and other games while they learned to keep themselves motivated and to understand sequencing and counting (Bhatti et al., 2017).

Using self-study methodology has helped me to reflect on the methods that I have been using such as the telling method and the textbook method. I realised that these methods may have had an effect on learners' ability to understand patterns. I then planned and used methods that involved learners in their learning (Pinnegar and Hamilton, 2009). I reflected at the end of each lesson and this helped me to determine when the lesson went well and when it did not. This aided me in correcting mistakes before commencing the next lesson. A learner-centred lesson plan is different because it ensures that learners are experimenting, playing and enjoying while they learn.

Collage making



Figure 2.2 Collage showing my life history

According to Tidwell and Jónsdóttir (2020), collage intervenes to give more understanding and interest about the topic to both the person who created the collage as well as the person who views the collage. I used a collage to help me discuss the learnings I got from my personal history in chapter three. I also used a collage in chapter five to reflect on my study and it helped me to summarise different topics in my study. Masinga et al. (2016) define collage as a poster-like chart or paper consisting of different images/photographs as well as pictures from different magazines which can relate to a certain journey involving a group of people showing emotions, pasted together to make one big picture. Hence, to begin my chapter three, I collected pictures from my childhood to primary school, from primary school to high school, from high school to tertiary education and from tertiary education to my work life. The collage helped me when I related my past experiences as it reminded me about all the events and memorable experiences. I related the story to what may have contributed informally or formally, to the way I felt about mathematics and patterns in particular. So, I used collage when I generated data and also when I analysed the data. As Pinnegar and Hamilton (2009) affirm “in self-study research, collage has been used both as data collection and an analytic tool to prod our thinking” (p. 130).

I also gave learners a chance to construct their collage. Learners collected pictures that had pattern drawings such as dresses, animal skins, cushions as well as table and floor mats. They

then worked together in their groups to create one big collage. Using one of the most interesting collage from the learners, I taught pattern attributes. Learners enjoyed placing flashcards on the chart to describe patterns using different attributes. This generated more understanding of patterns, which is not easy to forget because they were involved in identifying patterns from magazines and they love pictures. By making their own collage, they were recollecting their learning experiences and reconstructing them into meaningful pictures (Gerstenblatt, 2013).

Using learners' work to reflect on the improvement

Learners' work included activities that are planned for learners to do, while they learn such as work sheets, classwork, homework and assessment tasks (Moss et. al, 2008). As Felder and Silverman (1988) propose, I carefully planned worksheets, puzzles and games taking the learners' intellectual levels into consideration, so that the intended outcomes will be achieved. Learners were involved in making their own objects such as shape cards that were used to teach increasing geometric patterns. I wanted to make their learning as practical as possible. When learners are active while learning, they gain control of their learning so that they understand better (Aktekin, 2019). Learners actively constructed their own knowledge and understanding around patterns using activities and games that were connected to real life situations (Vale, 2013). Learners' work in the form of worksheets, classwork and homework showed how their understanding of patterns has improved and I used this to inform me of learners' understanding and to reflect on how the lesson progressed.

Memory Drawings

Drawings are part of the Visual Arts curriculum but are also used across the curriculum including mathematics (Barwell, 2003). In chapter three, I sketched memory drawings to remind me how my environment contributed to my learning of patterns. For example, the drawings of my homestead, the garden and 'here we go game' were my earliest engagement with patterns. The drawings highlighted moments in my personal history which were significant to the way I understood and taught patterns in mathematics (Tidwell & Jónsdóttir, 2020).

I also used drawing to provide my learners with a lens to understand things without being told as LaBoskey (2004) explains. Drawings, just like any other picture or image, arouse interest in learners. Learners were motivated to participate in the lessons because there were many pattern

drawings especially in geometrical patterns. Pithouse-Morgan and van Laren (2012) claim that drawings can help learners convey their emotions and they can express themselves better using drawings. I also used drawings in my collage where I could not find suitable photographs or pictures.

Audio-Recordings

For decades, audiotapes were used to collect data in different research by recording interviews or conversations or discussions between two or more people (Phillips, 2018). Since technology is growing faster, our lives have become more manageable. I used my cellphone to record the audio between my critical friend and me and my supervisors. Classroom activities were also recorded as all issues of ethics had been addressed.

In most instances, audio-recording has many challenges such as the speaker's accent, colloquialisms, and unclear sound (Bokhove & Downey, 2018). On the contrary, the challenges did not apply to me because we code-switched between our mother tongue and English and which I translated during transcription. According to Birch and Whitehead (2020), the benefit of using audio-recording is that it reduces the risk of memory decay. It helped me capture data that informed my decision-making processes as I took in the suggestions made.

Data Analysis and Interpretation

The data generated was qualitative so analysing it depended on interpretation (Creswell & Poth, 2016). My data analysis was inductive because it emerged from the data in response to my research questions. When I created my first collage on my personal history, I got excited and missed the point that my personal history (see chapter three) should be related to my title which was based on how I was taught patterns. When I presented my collage to Miss K., my critical friend, played an important role because she channeled me to keep to the topic in my collage. I became so confused and frustrated because when my critical friend and I were still learners, patterns were not part of our mathematics curriculum. My critical friend was there to give me emotional support and she assured me we were going to find solutions to the problem.

Reading literature on patterns, made me realise that there was more to patterns than I had anticipated, because I learned that, concepts like counting forward and backward, sequencing numbers, actions or words in a song or game and making sense of the commonality in an object

were part of patterns and had always been like that even before I started school. Conducting this self-study made me realise that as teachers, we are supposed to be life-long learners. After responding to my first research question: *What can I learn from my personal history about learning patterns?*, I was asked by my supervisor to identify the learnings from my story which formed part of my data analysis as I had to read and reread my story to make meaning of it.

My critical friend helped me organise and rearrange my personal history narrative according to the most negative and most positive memories. I then discovered the following four learnings: *creating a positive learning environment for learners, employing practical based learning, understanding parental involvement in learners' education and incorporating games into learning patterns.*

For my second research question: *How can I improve my teaching of patterns to grade two learners*, I used the above learnings to collect data and to correct the mistakes of the past when I designed lessons for this self-study (see chapter four). My critical friend helped me organise and make meaning of my findings (Samaras & Roberts, 2011). I listened to the audio recordings and videos taken while I was teaching. This helped me to capture the reality because I was then a spectator of my actions and learners' actions (Girit & Akyüz, 2016).

Trustworthiness

Since my study was a qualitative study, it cannot be easily validated because quality is not measurable or countable as it is in quantitative studies (Creswell & Poth, 2016). Denzin and Lincoln (2011) constructed concepts of validity such as trustworthiness and rigour that are suitable to a qualitative study. Samaras and Roberts (2011) are convinced that self-study validity depends more on collaboration with colleagues and critical friends. Hence, in my study, I have been transparent with my colleagues about my study and I have worked with help from my critical friend.

To ensure the truthfulness and/or trustworthiness of my study, I pursued a step-by-step process and I made sure that the study was based on improvement. Evidence of learners' work in the form of learner journal, worksheets, puzzles, hopscotch and drawing are included in the study in chapter four and five, where I reflected on my study (LaBoskey, 2004). I gave clear detailed explanations of how I generated data using self-study methods such as a personal journal,

learner journals, lesson plans and learners' work as Feldman (2003) advised. Feldman (2003) further offers that the purpose of self-study is to improve the researcher's practice. Therefore, I described the extent to which my study has brought positive outcomes. Learners' work as well as class visit reports from my departmental head also served as evidence of improved performance, thus strengthening the trustworthiness of my study.

Challenges in the study

As indicated, I worked with my grade two class. The challenge I faced while working with learners came from parents who were calling me on my phone about the consent forms. This was brought on by the fact that they could not sign the consent forms without fully understanding what they were signing for. In responding to this challenge, I requested the principal to call a meeting for my learners' parents so that I could explain to them face to face the reasons why I was requesting them to give consent to their children to participate in my study. I asked my principal for the permission to call them to the meeting and after explaining the study to them, they were happy to sign the consent forms.

Another challenge I faced, was overcrowding in the classroom that was the result of a shortage of classrooms. I taught a class of 65 learners that limited the space in the front of the classroom for my learners and me to do some activities. I therefore overcame the space problem by taking learners to the field for physical activities for playing games and counting. These challenges taught me that, as a self-study researcher that most solutions to most problems should come from me, as a sign of my growth and improvement (Samaras, 2010).

Conclusion

In this chapter, I addressed the processes of self-study research. I began by defining self-study methodology, giving the reasons why I chose it as my methodological approach for my research study. I went on to describe the context of my research followed by a description of my research participants while clarifying their role in this study. I then got to data generation where I started by drawing a table summarising data generation methods according to how I used them to respond to my two research questions. I then discussed each data generation method used and I referred to the chapters where I used them. Data analysis and interpretation was also discussed and then I talked about how I tried to establish trustworthiness for this study. Finally, I spoke about the challenges I had to face during the research. In chapter three, I present the collage

and use it to tell my personal history in relation to the learning and teaching of patterns in mathematics.

CHAPTER THREE

WHAT CONTRIBUTION DID MY UPBRINGING MAKE TO THE WAY I TEACH NOW

Introduction

In this study, my focus was on teaching patterns in mathematics to grade two learners. My purpose was to take a closer look at my personal history as well as my current practice to find ways to improve my teaching of patterns. As Magubane (2014) asserted, "...it is important that we draw lessons from the past so that we can avoid committing the same mistakes that we or others made" (p. 58), I drew from my past experiences, to answer my first research question and find ways to improve my practice.

In the previous chapter, I set forth on my self-study research process. I gave a detailed definition of the self-study research methodology and discussed the methods I used during the generation of data. I then described the context of the research and revealed the research participants and my critical friends. In conclusion, I dealt with issues of trustworthiness as well as the challenges I faced during the study and how I tried to overcome them.

This chapter takes me back to how I grew up and how my upbringing made me who I am today. It pays attention to the first research question of this study: *What can I learn from my personal history about learning and teaching of patterns?* I begin by looking at my home environment where I was born, at the people who were around me then, and my family. I highlight the pattern lessons I was unwittingly, taught while doing everyday chores. I then dwell on the indigenous games that I played in the village even before I got to school. All the games carried pattern lessons since they involved sequencing of actions or singing. They had logic and meaning because I knew the wrong moves could put me out of the game.

Before I even give details of my early days of schooling, I place attention on my father whom I regard as an inspiration and an icon throughout my education. My education began with him deciding to take me to school, because in my village at that time, taking a girl child to school was not a wise choice, according to the community. Furthermore, he showed so much interest and happiness in my success with my education and that encouraged me a lot. I then delineate my primary school educational journey since it carries much significance to my lessons on learning of mathematics and patterns and on how I was taught and in what way my teachers' teaching methods affected the way I am teaching now. This is pertinent to the focus of this self-study.

In addition, my high school education is vital to this research study, because in my view that is where the gap in learning mathematics took place. I also highlight my training as a teacher and my partial but worthwhile involvement in mathematics learning. Then, I look at my early teaching experiences and the problems I faced when teaching patterns and other concepts in mathematics. Finally, I give the learnings I acquired drawn from the recollection of my personal history and analyse them with the aid of a collage.

Informal education I acquired on patterns

I am the tenth child of twelve children (4 girls and 8 boys). Four of my brothers passed away before I was born. I never got to know them. I grew up in a big family with both parents, my four brothers and four sisters. My father did not have a stable job. He was a house builder and worked part-time, building houses for the community. As a builder, my father had some mathematical skills, which was useful, such as, estimating, measuring and counting skills he used when he was building. I used to observe his building tools, which included a line level and measuring tape. When I looked at the numbers written on these tools, the informal education of number symbols was embedded in me as Winter, Salway, Ching Yee, and Hughes (2004) hypothesise. I got used to looking at the number symbols even though I did not know what they meant at that time. Hence, when I started school, number symbols were not exactly new to me.

I grew up in a deep rural area in a small village called Nongoma in KwaZulu-Natal. My homestead comprised mainly of 'rondavels' which is a large room with thatched roof and squared walls with zinc as a roof. Figure 3.1 below is a drawing of my homestead with rondavels.

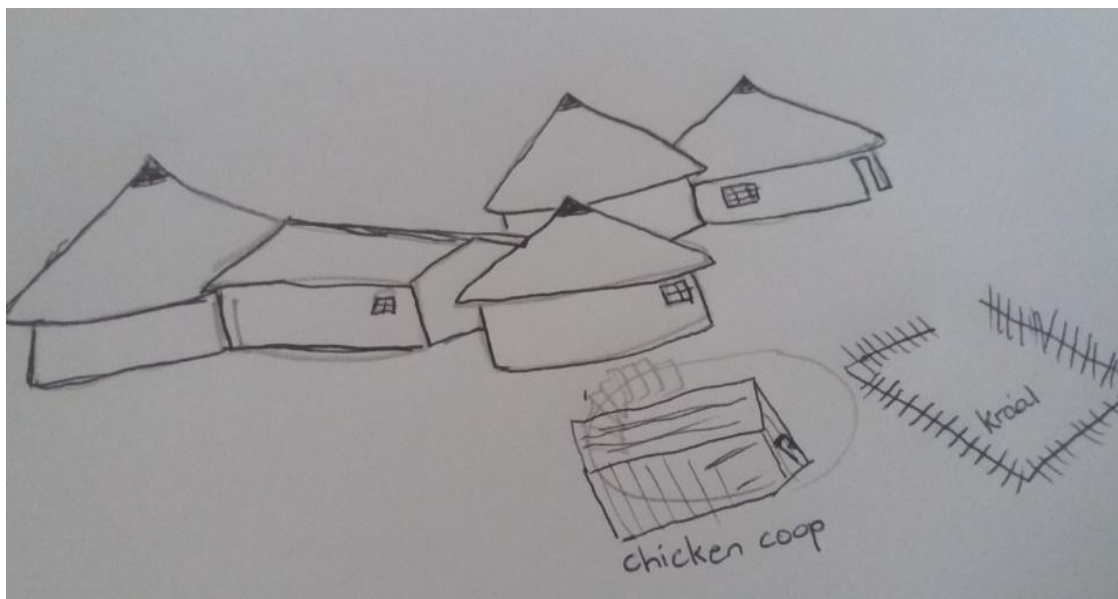


Figure 3.1 my homestead with rondavels

The floors of the rondavel I lived in were cleaned and smeared with cow dung. The house where my father and mother slept was different because it had concrete floors and it was polished with melted candle wax mixed with paraffin. From an early age, I learned that boys and girls performed different tasks. When looking at this demarcation of jobs, I realise that boys were trained to be tougher, as they were prepared to become providers and heads of families while most of our chores as girls, took place inside the houses or near the home which, informally, taught us to become home carers (Rankhotha, 2004). In our home, boys were responsible for milking the cows and taking the cattle out in the morning and returning in the afternoon. My father also took the boys with him during the weekend to help in his building business. Girls were responsible for feeding and counting chicken and doing many chores in the kitchen such as cooking, cleaning and fetching water.

At that tender age, I could list the chores done by females, the chores done by males and the chores done by both females and males, which created a pattern. I could also sequence the list of chores we did from the time we woke up until the end of the day. Also, my father kept stock such as cattle and chicken. This taught me some counting skills based on real world examples. Counting is part of patterns since it is about the sequencing of numbers. Even though I could not count the chickens using numbers, I was able to see that they were all there as I categorised

them according to colours and size that in turn was my earliest encounter with patterns using attributes of colour and size.

While my mother was planting crops, I would help by holding the bag of seeds while she planted in a row. I noticed that the planting she did was by forming straight lines and even when we watered the crops, we had to follow that pattern of straight lines. To make straight lines, my sister and I, used to hold a cord at the edges and then place it on the ground in straight line. My mother would dig under the cord making a fallow where she planted the seeds. This accentuates the fact that the way we were taught patterns at home was natural and practical compared to the way we were taught it when we got to school and the way I am teaching it now. I say this because I have realised that almost all the mathematical skills we informally learned at home, were pattern related. Mulligan and Mitchelmore (2009) concur that, “all mathematics is based on pattern and structure” (p. 1). Figure 3.2 below, is a drawing illustrating a pattern of a straight line.

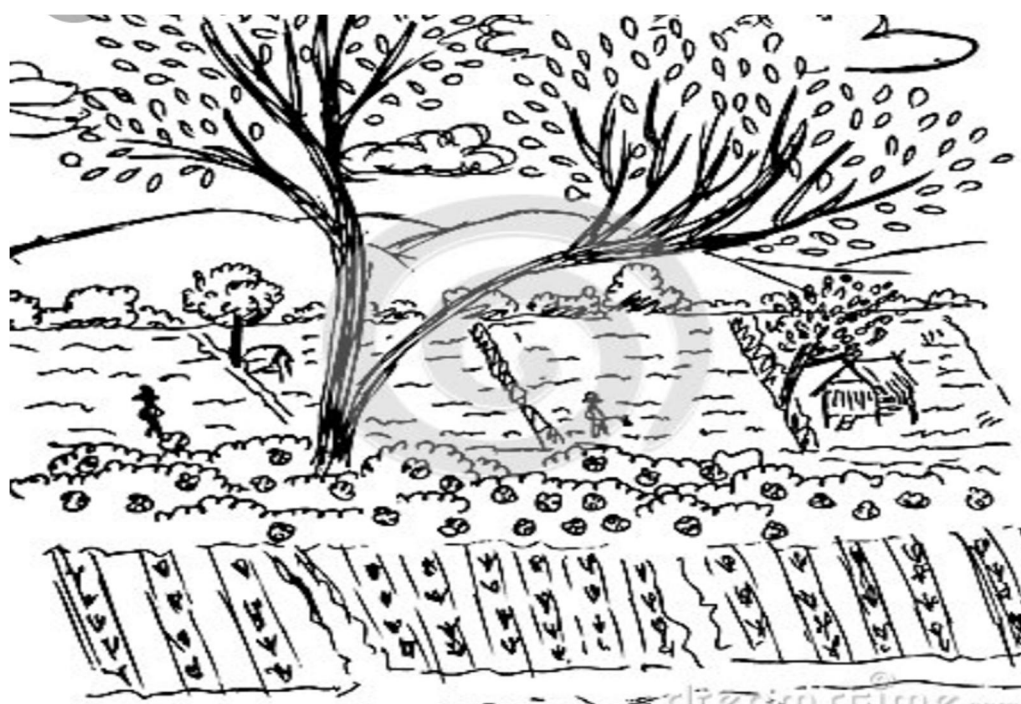


Figure 3.2 recognising a pattern in the garden

The role played by indigenous games

We had so much work to do in the village but we also had a chance to play with friends. We played in the river when we went to fetch water and in the field to collect wood. It was so

exciting because we used to go with our siblings who were already at school, so they played with us and they taught us new games that they learnt at school. Some of the games we played were ‘umagenda’¹ and ‘here we go’ (see figure 3.3 below). ‘Here we go’ was an English game that we learned from children in the area who were already at school. The game song was as follows:

Here we go

Down, down, down,

Here we go up, up, up,

Here we go backwards and forward

And here we go round, round.

We understood the sequence and pattern of actions and we enjoyed playing the game. We started by going down, then up, then we moved backward and we moved forward and lastly we turned around. This also shows me that patterns can be integrated with other subjects such as Life Skills. As a teacher in the foundation phase, I have the flexibility to integrate the lessons in the Performing and Creative Arts and Life Skills, with patterns in mathematics because I teach all subjects. Figure 3.3 below is a drawing of the game we played.



Figure 3.3 “Here we go”, game that taught me sequencing

¹ Umagenda is an outdoor game played using stones that are placed in a drawn ring. The player throw one stone up and move certain number of stones out of the ring before they catch the one they threw.

Most of the games played by girls, were played in groups and focused on enjoyment rather than winning (Adler, Kless & Adler, 1992). The game illustrated above is an example of a game played by girls for enjoyment.

Another game we used to play even before we got to school was “Gxa²” (hopscotch). The game taught us to count and to recognise patterns of sequencing numbers when we count. We also noted a relationship between the number and the number symbol written by our elder siblings. As part of home education, we had learned numbers one to ten on different occasions. Figure 3.3 is a drawing of the hopscotch game we used to draw and play.

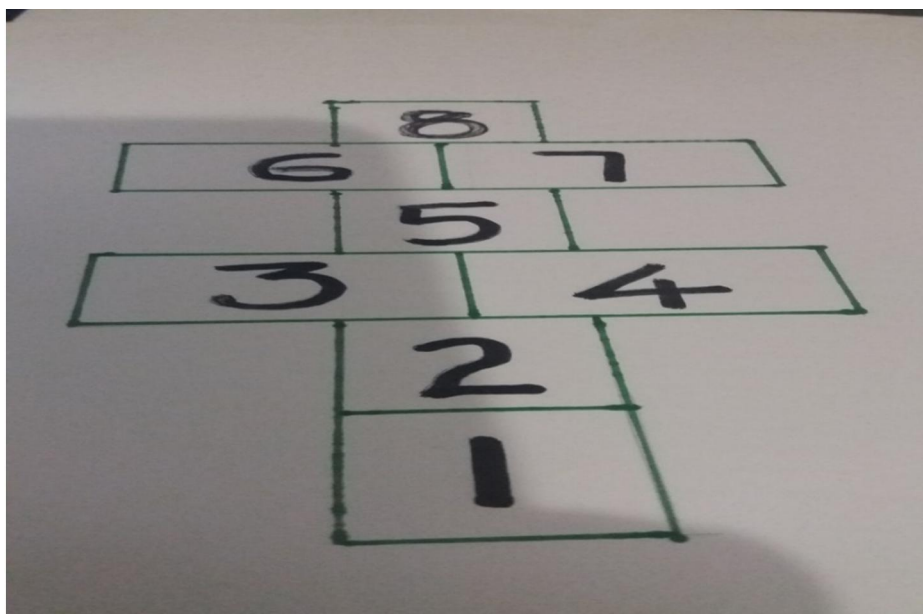


Figure 3.4 Hopscotch (gxum-gxa) game

My inspiration for education

² A game where players would toss an object onto a numbered square drawn on the ground. The players would hop through the numbered squares until they got to the object.



Figure 3.5 my father, my inspiration

My father was not educated but he showed so much interest in our education. He used to tell us how important education is. He told us that he also wanted to learn but circumstances did not allow him. He grew up on a farm where the highest class he could attend was standard four (grade six). Thereafter, he was compelled to work on the farm for the farmer who did not pay them as workers because they were staying on 'his land'. He wanted to make sure that his children do not go through what he went through, that is why he left the farm when he married my mother.

My father used to read *Ilanga*, the newspaper that he ensured he got, even if he had said there was no money. The newspaper was available twice a week, Mondays and Thursdays. The older newspaper was taken to the pit toilet and used as a toilet paper. Before we could take it to the toilet, we had to make sure that it was not the latest newspaper that my father was still reading. I noticed that the words "*Ilanga*" were blue on Mondays and red on Thursdays. I used those colours to identify which newspaper came first. Then as soon as I learned numbers, I looked at the dates which taught me a number pattern since I had to know which number (date) comes first because sometimes my father took long reading his newspapers and the newspapers for the previous week got mixed with the current week's newspaper. He was so happy and he praised me for being able to read the words as well as numbers at my age and grade.

He would encourage us to read books especially the bible, since he was also an evangelist. We knew how many letters there were in the bible and we, also knew the bible from Genesis to

Revelation sequentially. My father was the one who always asked what we learned at school and that encouraged me to be alert at school. He was involved in my learning from my primary to high school.

My primary school journey

In 1978, I started school at a small primary school in my village. It was a poor school with limited classrooms. The classes started from Sub A (grade one), then Sub B (grade two), then went on from standard one (grade three) to the highest grade for that school, standard five (grade seven). Sub A and Sub B used the Methodist church building which was built inside the school. According to the history told by our teachers, the school was built by this church in the early fifties which explained why the church and the school were in the same premises. My older brother and I went to the same school and he showed me my classroom on my first day at school. I started school in Sub A since the schools in my area did not have grade R at that time. As mentioned above Sub A and Sub B used the same 'classroom'. Sub B, seated with their backs to us, in the same room facing the opposite direction with their teacher in front of them. It was not easy to concentrate but as time went on we got used to listening to our teacher only and besides, we were usually punished if found laughing or looking at the Sub B class. I notice now that the learning environment for us was not conducive for effective learning to take place.

During mathematics lesson in that first week, our teacher taught us to count from one to ten. As she counted, she was releasing each of her fingers and we followed her. If it happened that we skipped a number or could not order the numbers correctly, the teacher stopped us and corrected us. It was not my first time counting from one to ten even though I was not perfect in counting. My older siblings had played being teachers at home and taught me to count. I also learned to count from one to ten when we played hopscotch. So, when the teacher taught us to count, I felt a little bored as we were repeating over and over something that I already knew. I feel that the teacher should have tried to find out how far we could count to and then she could have used concrete objects in the classroom such as desks, learners or books to teach us to count just as Battey, Neal, and Hunsdon (2018) point out that young children should be given a chance to learn number sense, using real objects to count.

When I started my senior primary school in standard three, the female teacher who taught me was a Xhosa lady from the Eastern Cape. She was very strict. She shouted at us most of the time and she would hit us if we did not do as she expected. Battey et al. (2018), emphasise the

importance of creating a caring learning environment. It was not like that in the case of this teacher. We were so scared of her. She made us attend the morning classes before school started for mathematics. That was good because she made sure we got individual attention during the morning classes. But to us, at that time, it meant suffering. We got punished for coming late to class, which we thought was not fair because it was before the school starting time. Madide (2018) believes that teachers' behaviour lead to learners disliking mathematics. Similarly, I developed negative attitudes to mathematics. My older siblings who walked with me to school and who were doing standard four and five, refused to leave home early, so I had to walk the long distance alone.

Another scary moment was when we did mathematics sums on the board while the teacher stood behind us and watched how we did the calculations. She would hit us on our ears if we made mistakes or got the sums wrong. As a result, we developed negative attitudes towards mathematics as a subject and the morning class that was, meant to help us. We also developed immense fear for the teacher. Nevertheless, our parents were fond of the teacher and praised her as a great teacher who took her job seriously. During that time, it was believed that corporal punishment was the only way to discipline children (Durrant, 2000). Although the reinforcement was negative, we all passed mathematics in standard three. We learned mathematical skills such as counting forwards and backwards, using four operations such as addition as well as also other unsavoury skills such as copying from each other if the chance to do so availed itself. This is in keeping with what Vally, Dolombisa, and Porteus (1999) insinuated that corporal punishment impacts negatively. In our case, copying was the negative impact, because we would do anything to avoid the corporal punishment.

As young as we were, we could not help but notice, that mathematics was regarded as the most important subject even though we did not know the reason. It was awarded more time than other subjects, and we had more homework in mathematics than in other subjects. Similarly, Hornung, Schiltz, Brunner, and Martin (2014) concur by declaring that also in the USA, mathematics knowledge is a central goal of education.

Memorisation or learning rote fashion was the way we learned. We used to sing times table by heart. This was also a form of punishment if you failed to give a correct answer to a multiplication sum. The teacher would make you stand in between the blocks of classrooms and shout loudly as you repeated the multiplication tables. The learners in other classes would laugh at you because you looked like a fool shouting outside. I tried to imagine now, how other

teachers felt about the distraction. An example of the times table, we were expected to recite correctly, is provided below:

Four times one equals four

Four times two equals eight

Four times three equals twelve

Four times four equals sixteen

Four times five equals twenty

Four times six equals twenty-four

Four times seven equals twenty-eight

Four times eight equals thirty-two

Four times nine equals thirty-six

Four times ten equals forty.

Reciting and singing these tables did not help us to recognise the pattern of skipping three numbers to get to the next answer when we sang the table of four. Reciting was meant to help us master times table and to get the answer quicker. However, it remained just a poem because we got the answers incorrect when we wrote multiplication sums. Actually, we just learned parrot-fashion because if someone asked us to multiply four by eleven, the answer would be wrong because our rote learning ended at the number ten. This method denied us different ways of doing calculations, which could have been more meaningful. When I passed standard three, things got better. My teachers in standard four and standard five were not that harsh even though they all used corporal punishment.

When I look back at how I was taught mathematics, especially in the primary school, I realise that teachers back then, did not expose us to different ways of getting to the correct answer. Driscoll and Driscoll (2005), put forward that teachers should expose learners to different ways of solving a mathematics problem. For example, since addition was so much easier than multiplication, to master multiplication they could have taught us to do repeated addition to

make it easier for us to find the addition and multiplication relationship as well as the pattern of how many two's make ten for example ($2+2+2 = 2 \times 3$). This would also help us find the correct answer by ourselves thus letting us recognise the pattern rule instead of memorising the table without or with less understanding.

My high school life

In 1985, I went to a secondary school which my older brothers were already attending. It was also in the same rural area as my primary school. The school was bigger and physically better than my primary school. The number of learners in each class was much bigger than in the primary school. It was a new school, with classes from standard six (grade eight) to standard eight (grade ten). My father was the chairperson of the school governing body, which was called, school committee then. He also got building jobs at the school. I think my father was more involved and showed more interest in the school affairs than other school committee members.

Our school needed a new block because classrooms were so overcrowded. Three to four learners were seated in one desk which, made it difficult to write freely. We were squashed next to each other and on summer days, the heat was unbearable. As a result our concentration was diminished. We usually made a lot of noise even when the teacher was in front of us. If you sat at the back of the classroom, you would not hear what the teacher was saying because learners at the back, mostly boys, were behaving very badly. Consequently, the learning environment was not conducive enough for learning (Rossouw, 2003). I do not know whether it was because of our behaviour or teachers were too busy, but we had more free periods in standard six. Some subjects were not taught for weeks.

Only two teachers were teaching almost on a daily basis and they were the only teachers who respected the time-table. Those were teachers for mathematics and general science. They always availed themselves especially the mathematics teacher. He even used the periods for other subjects. Most children especially boys, did not like the fact that he was using other teachers' periods because they wanted to enjoy more free time in the classroom. This shows the lack of self-discipline and motivation to learn. The mathematics teacher was trying his best even though there were no resources. Most parents could not afford to buy textbooks since many of us came from poor family backgrounds where parents had low or no income. Ashby and Schoon (2010), in their findings on the impact of family social status, revealed that low social status impact on children's education. There was no library in town or at school and

there were no photocopiers or even electricity at school. Our teacher was the only source of information with the chalkboard as the only resource they used.

The seating arrangement in our classroom did not favour group discussions, collaboration or comparative learning (Panitz, 1999). We were all sitting facing the front. The telling method was the obvious method used by most teachers. In order to pass, we rote learned what teachers had told us just like in the primary school. It was difficult to understand mathematics because it demanded both conceptual and practical learning, as I understand it now. This understanding is confirmed in the research findings by Barron and Darling-Hammond (2008) that learners learn better when they apply knowledge related to real life problems.

I understood most concepts in mathematics, so I developed a love of the subject. My two brothers who were doing standard seven and standard eight were both good at mathematics especially algebra so they always helped me if there was something I could not understand in class. I was not that confident in algebra because I failed to identify the commonality and regulation of the spatial and numerical structures, so I could not expand the structure (Mulligan & Mitchelmore, 2009). My brothers helped me to first look for a commonality of a sequence and to generalise the commonality to all terms of sequence. For example in a sequence of multiples of 4: (4; 8; 12; 16; 20) they made me understand that every number here is a pattern of 4 times its position in the sequence. Therefore, the second number is equal to 4×2 , the third one equals 4×3 and so on and so forth.

Sometimes I was the only one who got the sum correct through my brothers' help. My teacher would call me to the front to explain how I got it right. Even my friends started to rely on me to help them when we prepared for exams. Helping them also helped me in turn because when I explained something to them, I usually learned something new and sometimes got a new easier method to do certain sums from my friends. I then learned that mathematics was understood better through discussion and practice. As Bhatti et al. (2017) suggest, activity based learning and learner involvement assist learners to acquire knowledge and practical mathematics skills.

When I began standard eight, a new teacher came to our school. He taught us mathematics and biology. At first, we did not understand him and we were afraid of him because we did not know what to expect. The new block of classrooms was finished by then and because in standard eight (grade ten), we used to choose our direction of study to the final matriculation examination, we were not packed in one classroom anymore. Our new teacher used to arrange

us to sit in groups and gave us sums to do as groups. We then presented what we came up with as a group to the whole class. Since the method was new, and as Samaras and Freese (2009) highlighted, working in a group can cause fear, we also felt uneasy about sharing our thinking with others as well as the whole class. Gradually, we got used to this method as we began to understand that we learned a lot from each other as we collaborated, interacted and discussed while solving the mathematics problems (Masinga, 2014).

The teamwork helped me understand and interpret algebraic letters as generalised numbers. While we were trying to use variables with operators, we discovered that we had lots of confusion. (A variable is a letter representing the certain number that we do not know yet and the operators are multiplication, division, addition and subtraction). For example, in our group we thought that $4x = 4+x$ so if $x=4$, we used to come up with the wrong answer which was $x=8$ because we used addition as the operator. Since our teacher was moving from one group to another, he picked up where we made a mistake and corrected us that $4x$ is actually *4 multiply by x*. We then reworked the sum in a correct way. The fact that he was able to help us individually or in small groups, showed us that he cared about each one of us. Like other teachers, he used corporal punishment but not that much and when he used it, he made us understand the behaviour he was punishing us for, hence we avoided repeating the same behaviour.



Figure 3.6 Picture of myself taken in a Science laboratory even though we had no science teacher

The following year 1988, I had to be a new entrant again, in a new school. This school was well built, even had a laboratory for Science subjects but there were not enough teachers. When I started standard nine, I was so sure I was going to be in the mathematics and science class. Surprisingly, there was no teacher to teach physical science. There were two streams, the one doing general subjects that included history, biblical studies and biology and the second one which was supposed to be doing mathematics and physical science but instead we were doing mathematics and biblical studies (Bibs). The teachers told us that when the physical science teacher arrived, we were going to stop learning biblical studies. At that time, we were not aware of the importance of choosing the correct course of study and how this influences the kind of job we were willing to train for when we finished high school.

I was happy to be in a mathematics class but I was not happy about the way that teacher taught us. He used to quickly write the sum on the board as an example and gave us other sums to do as he had done on the board. He took little time to explain the formula and the method of calculations. When some of us asked questions, he would be very unhappy and would shout at us. He robbed us of a chance to explore mathematics ideas and opinions by never allowing us to use different methods of calculations to get to the answer even if it was the correct answer (Olson & Barrett, 2004). There was always a stick in this teacher's hand. Sometimes when we asked questions, we would be punished for not paying attention when he explained the first time. During those times, children were expected to take what teachers and parents said and were never allowed to question their order. It was called respect but sometimes it impacted negatively on our ability to take decisions for our future education and careers for the future.

When Murray (2011) interviewed learners about a good mathematics teacher, most findings included words like approachable, giving individual attention and does not put children down. These words could not describe this teacher. He prevented us from being critical thinkers in his class, since we were not given a chance to construct knowledge and solve problems (Kwan & Wong, 2014); (Battey et al., 2018). He was unapproachable since he practiced corporal punishment. Morrell (2001), in his research on the use of corporal punishment in South Africa, questioned the learners about how they felt about corporal punishment and many of them revealed that they felt angry, scared, hurt and sad. That was how we also felt in his class. Figure 3.8 below, is a drawing representing our mathematics class which I labelled "Doomed moments."

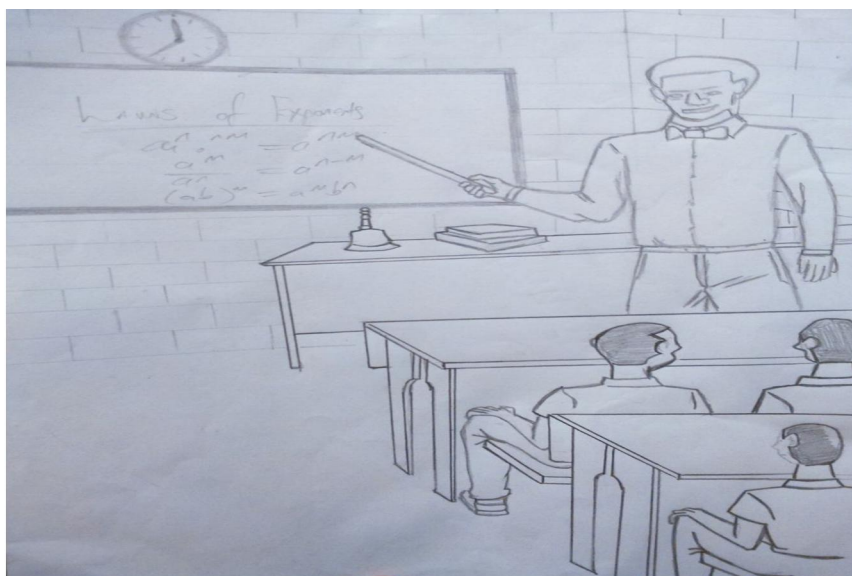


Figure 3.7 A drawing representing my mathematics class which I titled “Doomed Moments”

My neighbour, who was also a teacher in my new school, told my father that there was no stream for mathematics and biblical studies, and that I was going to have a problem when I register for standard ten final examinations. It was already March and teachers as well as the principal were promising that they were waiting for the physical science teacher. Since my father wanted me to be a nurse, he asked that teacher if it was possible for me to do nursing with general subjects such history, biology and biblical studies when I finished school. The teacher assured him that it was possible, so my father went straight to my school and asked my class teacher to place me in general subjects class and sadly, that was the end of me and mathematics. I wasn't even sure if I wanted to be a nurse or not but I knew that I didn't want to disappoint my dad or defy his authority and jeopardise that father-daughter relationship we had (Lesch & Scheffler, 2016). In the end, I just convinced myself that I wanted to be a nurse.

The problems in the mathematics class led to learner strikes at our school. The learners who were doing mathematics began complaining that their mathematics teacher could not teach mathematics and organised a protest against him. They held meetings and they refused to go to the classroom at one time and ordered the principal to give them new two teachers, one for mathematics and the other one for physical sciences. They were blamed for causing unrest in the school. When I thought about speaking to my father about the strike, I felt so relieved that I was not part of it.

The Department of Education was failing us as learners. This was similar to what happened during the Soweto uprising in 1976 when learners protested against the learning of Afrikaans which resulted in the police shooting the children with live ammunition and killing the legendary Hector Peterson (Baines, 2007). My school had prepared itself for offering science subjects so the laboratory was built but the Department of Education could not assign a science teacher to the school (see Figure 3.7 above)). Even though the reasons were valid, the right to strike was not given at that time. The principal explained to learners that they were failing to get another teacher for mathematics and they were still waiting for science teacher. So, the principal decided to reshuffle teachers and gave them the teacher who was teaching mathematics in grades nine and ten. In my mind, I started to see how important these subjects were and I felt like I was already missing out, on becoming the important and most wanted teacher even though I knew I was going to be a nurse. I thought about my teacher who taught me mathematics and biology in standard eight and I imagined being a mathematics teacher like him, but that was a passing dream. I passed standard nine (grade 11) and in standard ten (grade 12), I also passed with good results but without mathematics though.

The following year which was 1990, I stayed at home the whole year doing nothing. My friend and I wrote applications for employment as trainee nurses. We sent them to the nearest and furthest hospitals. They all responded that there were no vacancies at that time. Only one hospital promised to put my name on the list for nurses who were going to begin training in July the following year. My father sometimes felt that I was not trying hard enough to look for a job. He always asked me to go check for the mail. I could see that he was disappointed when I always told him that I had received nothing or that my applications were unsuccessful. It was so stressful to stay at home alone with my parents. I had to do all the chores while my younger siblings were at school. It was so boring in such a way that I wished I had not passed my matric. At least I would still be at school with friends.

My father was still a member of the school committee at the same school but he was not a chairperson anymore. He was still very close with the principal. Seeing that I was staying at home, my former principal brought me two books. The first one had all South African universities and college addresses and courses. The second one had names and addresses for companies who offered bursaries. When I looked at these books and the fees, the first thing I liked was psychology. I read about it and I felt that I would like to become a therapist or a counselling psychologist. I noticed that mathematics was not a requirement then. Only English and biology were prioritised so I sent applications to different universities.

When I thought about my second option, the idea of becoming a teacher came to my mind again. I sat down and talked to my father about it. Apparently, he was not against me being a teacher but he explained that “nursing was studied for free and they would even give you money to buy books”. My family’s socio-economic status was determining my choice of career (Sui-Chu & Willms, 1996). He told me that if I got a bursary, he was okay with me being a teacher. I was accepted at a college of education in Pietermaritzburg and at a university in Durban to study Counselling Psychology. Since the fees at university are usually higher than at colleges and my love of being a teacher would materialise, I opted for the college of education.

I was so proud of my father because if it had not been for him, I wouldn’t have made it that far. He was my great inspiration from my childhood. He could have refused to let me go to college, obviously, because I was a girl. During that time in my village, they believed it was a waste of money to educate a girl simply because she was going to be married and expected to take care of the home while the husband was at work. There were already rumours that my father would regret sending me to college because I was going to get pregnant. Another reason for not allowing me to go to college was the shortage of money but instead, my father promised to do whatever he could to help me with my personal needs since I managed to get a bursary. Both my parents were very happy for me.

Tertiary Education

In 1991, I then began my college studies in a well known college of Education in Pietermaritzburg. It was a total different climate for me since I was coming from a deep rural area called Nongoma. My first day at college was registration day. It was very exhausting as we had to join long queues and moved from one station to the other for registration purposes. We were standing almost the whole day. At the end of the day, we were officially registered students with student cards and we were very excited. At this college, each hostel had its own dining hall so I was not going to see my friend as often as I wished. I then came to terms with that and we both found new friends quicker than we had anticipated. Soon, we adjusted to the college environment.

The first day of attendance was a disaster. Students had to move to lecture rooms and lecturers remained in their classrooms. That was also a challenge because we got lost most of the time. I was studying for a senior primary teacher’s diploma (SPTD). We had four major subjects and core subjects. I belonged to a certain class in which I did all core and didactics subjects. We

separated to do our different majors. Unfortunately, on the first day, we did not understand that and we did not really read the whole timetable for the day. When the first core class ended, we took it for granted that we had the same time-table. So, we followed one another to the wrong class. The few repeaters that were in the class, were mocking us. There was a class that I did not attend because I totally got lost. I went up and down the stairs looking for the number on the doors but I realised I had spent more than half of the lecture looking for the class. I ended up sitting on the benches in between the lecture rooms. I was tired and after I rested for a while, I decided to take my time and look for the next class venue to avoid getting lost again.

The manner in which we were taught at college was different from the way we were taught at high school. Our first challenge was that our lecturers were white people except those who were teaching isiZulu. It was my first time being taught by a white person and the language became a barrier at the beginning of the year but I soon got used to it and I started to enjoy my lectures because all lecturers were so kind. Also, the fact that there were so many resources at the college, made it easy to understand what we were learning. There were science laboratories, an audio-visual centre, Toams (maths and English self-assessment programmes on devices that looked like computers), an arts centre and many other facilities. Even for subjects like history and geography, there were educational tours to places such as the museum, weather stations and waterfalls that we visited to learn things that were relevant to our curriculum. This taught me that learning and teaching is always better if there are resources and that the classroom is not the only learning environment. Figure 3.9 below is a photograph taken during a field trip.



Figure 3.8 Photograph taken during a field trip to Howick falls conveying learning outside the classroom

Mathematics was not my major subject obviously, but since I was going to teach in the primary school, there was a subject, called mathematics didactics. The purpose of this subject was to teach us the method of teaching primary school mathematics since in the primary school we are required to teach all subjects. Learning to teach a subject meant that you have to learn some content knowledge of the subject (Der Valk & Broekman, 1999). We had didactics lessons for all subjects where we were taught how to teach each subject, even the subjects that were not our majors. I was happy, knowing that I was going to learn mathematics after all. Mathematics didactics was not as easy as I had anticipated. We used many textbooks and curriculum content from high school and very few from the primary school and that exposed my lack of knowledge of high school mathematics.

Patterns were part of the content we learned and by the time I was due to go on teaching practice to schools, patterns were included in the primary school mathematics curriculum. Students who were specialising in mathematics teaching, helped us a lot as they were also studying mathematics didactics with us. It was not difficult teaching patterns because I realised that it contained the concepts that I knew such as multiples, counting, sequencing and shapes. The only difference was that in patterns, I had to find out about numbers and shapes in a given pattern. Understanding this would result in a formula or a rule of that certain pattern. The trick in learning patterns as argued by Rivera and Becker (2008) is to recognise the regularity of a pattern. They further point out that this regularity should be noticed by learners whether they deal with numbers, shapes, music, rhymes and rhythms taking place indoors or outdoors.

Concurrently, du Plessis (2018) proposes that young learners are supposed to recognise the structure of a pattern through rhythm. This means that patterns in primary schools should involve some games, music, dancing or movement that is familiar to learners. During teaching practice, especially when we were assessed on our teaching, the college lecturers chose subjects and topics for us to teach. For primary school student teachers, any subject was allocated to you to teach, even if it was not one of your major subjects. I was allocated mathematics topics more than once. At my first lesson assessment, I was going to teach fractions and then, patterns. I did quite well in both lessons and my confidence in teaching mathematics grew. Even when I went on teaching practice to schools around the college and schools near my home, I taught mathematics.

My early years in the field

In 1994 I got my first teaching job in a nearest town called Mtubatuba. It was a new school in the area and all we had on the first day were buildings and desks. The staff comprised of the principal, who was also the first time principal, the other lady who was retrenched from the nearest school because she was unqualified, and me. During my first teaching experience as a newly qualified teacher, I was allocated the subjects and the grades I had to teach. Mathematics was one of the subjects I was supposed to teach in grades five, six and seven and patterns were part of the content I had to teach. It took learners a long time to understand patterns. I thought they lacked basic skills in mathematics such as counting and the value of numbers. It was difficult for them to recognise the commonality in a pattern if they didn't know which number is bigger or smaller and whether the sequence showed counting backwards or forwards (Resnik, 1997). I was also given the syllabus for each subject I was going to teach. The principal managed to get the syllabi from other schools. The syllabus stated what was supposed to be taught in a certain period of time. Even though I knew that learners lacked the basic skill of counting with understanding, I could not divert and teach something that was not in the syllabus for the grades that I was teaching.

Teaching was not as smooth sailing as I thought it would be. Not all learners seemed to be interested in learning. Some were misbehaving and distracting the learners who wanted to listen and distracting me while I was teaching. I did not know any other form of disciplining a child except corporal punishment. At first, I tried to avoid it because I knew how it felt when it was used on me but eventually I resorted to it, consoling myself that it's the only way to go. As Malak, Sharma, and Deppeler (2015) elaborated that Bangladesh teachers who did not know the correct measures of disciplining a child who misbehaves in class, resorted to corporal punishment. I felt like one of those teachers. I was so worried about this syllabus because I could see that with learners' distractions and their inability to understand, I was going to be far behind. It was not easy to continue with a new topic, while the learners still did not understand the current one, so I always tried to change my teaching methods in the hope they would understand.

I realised that even in grade seven, most learners could not count fluently and correctly. It was difficult to teach the mathematics content if learners could not count. Some learners could not even use the four mathematical operations of addition, subtraction, division and multiplication. Most of them had a problem when it came to multiplication and division but others struggled

even with addition and subtraction. That created a bigger problem for me when I was teaching patterns because they had to identify the commonalities that involved counting forwards and backwards, skip counting (adding and subtracting), noting the multiples and identifying geometrical shapes. It was difficult trying to teach them any mathematics concept when they lacked number sense which is a foundation for mathematics including patterns (Sood & Mackey, 2014). I was forced to begin by teaching them how to count and ended up not teaching what I was supposed to be teaching and thereby falling behind with the syllabus.

I was worried and confused. I thought maybe it was because I was not a mathematics specialist teacher, so the missing content might be causing problems in my teaching of mathematics and I thought that there was something lacking with my methods of teaching. Akyeampong et al (2019) conducted a research study on improving the learning of basic mathematics and reading in primary schools and discovered that African colleges of education focused on the subject content of a subject rather than the methods of teaching the content. I concur with their findings because when I was at college, time allocated for didactics was very little and there was a lot of content taught, instead of the pedagogical techniques.

Studying further

The problems I was facing especially in teaching mathematics motivated me to apply for further learning. I registered for a Higher Diploma in Education that would equate my qualifications to a Bachelor of Education degree. We had contact sessions at least once a month and then we also attended winter school. I learnt a lot more while I was studying for this qualification. It was not the methods and approaches that were new altogether, but what was different, was my purpose. My purpose when I went to college for the first time was to be a teacher but this time it had changed. I wanted to know how to teach learners who did not seem to be interested in learning like my learners. For example, I learnt about changing learners' seating arrangements that favoured group discussions. This seemed easy and we did this at college but in reality, it was not easy. Some groups decided to talk about things that had nothing to do with the topic and when presentation time came, they would make a lot of noise pointing at each other to go and present. Other groups cooperated very well and they learned a lot from one another. I found that while there were attempts at encouraging collaborative learning, it was not correctly facilitated.

While I was still studying, the Department of Education introduced a new approach to education which was called Outcome Based Education (OBE). OBE focused on competencies,

knowledge, attitudes and values that should be acquired by learners, while they learn since the approach was learner-centred. This new approach helped me a lot in my studies since most of the new teaching methods I learned were the same as the teaching methods introduced under OBE. I was not as confused as teachers who were not doing the course I was doing. OBE arrived with a new curriculum called Curriculum 2005. “A key feature of Curriculum 2005 was the decision that the first aspects to be developed, before any other structures were outcomes” (Nakabugo & Siebörger, 2001)

Mathematics as a subject, was greatly affected by the changes brought by OBE and Curriculum 2005. The name of the subject was changed to Mathematical Literacy, Mathematics and Mathematical Sciences (MLMMS). It was defined as:

Mathematics is the construction of knowledge that deals with qualitative and quantitative relationships of space and time. It is a human activity that deals with patterns, problem solving, logical thinking etc., in an attempt to understand the world and make use of that understanding. This understanding is expressed, developed and contested through language, symbols and social interaction (Department of Education, DOE 1997, p. 2).

Looking at this definition now, I can see that it focused on the construction of mathematical meaning which shows that it was based on the social constructivist approach. The weakest point of this curriculum was that there was too much integration and less specificity on what learners should know at specific grades (Spaull, 2013b). The government on the other hand, failed to provide more resources to support its introduction because if OBE was about activity - based learning, then resources were needed to make learning as practical as the new approach suggested. Understanding OBE was possible, but the application was another story. As a teacher, I was supposed to play a facilitating role and not the direct teaching role as I was used to. Letting learners share in the evaluation of tasks of peers and for themselves, was like a nightmare to me because my learners didn't know how to do it and they were not fair to others (Khoza, 2015).

A lot needed to be changed in a short period of time. The fact that OBE was criticised on media made it worse because most teachers would tell you that OBE was bound to fail just because it failed in other countries. In my opinion, OBE was a good approach which was not given a chance and which was unnecessarily politicised and misinterpreted. Another weakness of the new curriculum was the failure to give teachers adequate training to prepare them to be good facilitators of learning and not just teachers. Mathematics is a practical subject so this new

method was so relevant because learners were going to be active. According to Goodell (2006), teaching mathematics is not just about presenting topics and covering the syllabus. Teachers should strive to develop learner knowledge and higher cognitive skills. In my mind, I started creating lessons where learners would be given a chance to be active and to be more verbal than me. It has been ascertained that learners do not learn by just listening to the teacher. Just as Confucius' (2019) quoted:

I hear and I forget

I see and I remember

I do and I understand (Confucius, 2019).

Learning from my personal history

On thinking about the learnings from my personal history, I had to re-visit my narratives. I decided to ask my critical friend to read my personal story for me so that it would feel more like a story. When I listened to my story, emotions of fear, confusion, anger and joy surfaced. In my mind, I pictured what happened during the actual incident. My critical friend advised me to write down key words of what I thought was remarkable and of what I saw as a learning experience, while she read. I thought of the classroom atmosphere I experienced the methods and approaches my teachers used, how I could make my lessons more fun and the link between my home environment and school.

From the key words, I came up with four learnings: *creating a positive learning environment for learners, employing practical based learning, incorporating games into learning and understanding parental involvement*. The pictures I had in my mind about some memories made me think of using collage as a tool to analyse my learnings. Masinga (2016) characterises collage as a poster or chart with pictures from magazines that relate to a certain journey or experiences. I used collage in this stance to explore meaning of my own story (Chant, 2020). The collage shown below Figure 3.10 is a visual representation of my learnings from my personal history .



Figure 3.9 A collage displaying my learnings from my personal history

After creating the collage, I presented it to my critical friend because I wanted her to encourage me and to assist me make some adjustment in my collage. Again, I asked for permission from Miss K to record my collage presentation as well as her contribution. Miss K advised me to insert numbers next to the learnings written on the collage so that I don't mix them when I do my presentation to the supervisors. I then presented my collage to my supervisors for feedback and for getting their perspectives on my learnings (Samaras, 2010). My supervisors made me pause and asked for clarity so that I made sense of my ideas. They pointed out that I must clearly state the memory that influenced the learning, say how it made me feel and how it contributed to the new way of planning my lessons. In my collage, I arranged the images or pictures according to the numbered learnings that are written on the side of each row of pictures.

Creating a positive learning environment for learners.

In writing my personal history, one of the learnings that emerged, was a need for me as a teacher to create a positive learning environment for learners. The memory of my standard three (grade five) teacher, who had an angry face, reminded me of emotions of fear I used to experience in her classroom. As a child, I saw her not as welcoming because she did not even smile at us. She used to shout at us and insult us although we were little children and practiced

corporal punishment more than other teachers did. I remember one day when I sat in front of the classroom crying while I waited for punishment because I could not do the mathematics homework. Desks were usually empty because many children absented themselves from school to avoid punishment. Some even dropped out of school to escape the pain and embarrassment.

Another memory is of her sarcasm and her screaming when I could not come up with the correct answer. It left me with a low self-esteem. As a result, I avoided giving verbal answers in class for the rest of my primary school phase. Easthope, Maclean, and Easthope (2017) also agree that when a learner is in an unsafe environment, the mind is more aware of the need to protect itself than what is being learned just as I was saving myself from embarrassment in case my answer were not correct.

Hence, I have come to understand that the learning environment provided for the learners should be a safe place for learners and negativity should be avoided because it can cause future learning problems. This was what happened to me as I lost confidence because of the negative learning experience I got in grade five (Clapper, 2010). Additionally, Dweck (2007) and Magubane (2014) emphasise the importance of creating a trustful atmosphere as a teacher where learners can freely make mistakes without worrying about getting negative consequences. Moving forward, I will make every learner feel welcomed and accepted by praising their contributions in order to motivate them to participate even more.

Corporal punishment was one of the methods that affected the learning environment negatively. As shared in my personal history, my grade eleven teacher always carried a cane in his hand while teaching. Dlamini (2013) emphasise that if a child is exposed to violence, that child is easily noticed by being violent to other children and even to teachers (see the fourth picture of the first row in Figure 4.1), which interrupts the learning environment even more. Similarly, Straus (2010) points out that corporal punishment causes more harm than good. This rings true for me because my physical, emotional and social wellbeing was affected when I was severely punished (Bratteli & Robinson, 2012). I hope creating a positive learning environment will help improve my learners' attention and reduce anxiety.

Moreover, this teacher did not want us to ask if we did not understand the sum, to question his computation skills or the formulae he used even if they did not come up with the correct answer. He got us confused and we did not know what to do. It was always his way of doing the sum or we were wrong even if our methods were correct. Subsequently, this memory has made me realise that I am also not encouraging my learners to think of other ways of describing a pattern

or letting them use their ways of counting as long as they lead to the correct answer. This kind of environment is not positive because learners are not free to exercise their ability to think and solve mathematical problems by their own means. Therefore, promoting a positive learning culture in the classroom will help learners acquire motivation which will lead to more efficient achievement of learning outcomes .

Conversely, I am reminded of the positive learning environment that was created by my standard eight (Grade 10) mathematics new teacher. He was very positive and patient when he introduced us to working in groups. He used to walk from group to group supporting and helping us with the problems we were facing. He did not put us in an awkward position of embarrassment and he discouraged us mocking other learners. In addition, he would let us solve mathematics problems in collaborative small groups which allowed us to share our thinking in the interpretation of algebraic equations which were a problem to most of us (Mishra, 2014).

Furthermore, since mathematics was taught in English, in our groups we got a chance to explain to one another using IsiZulu, our mother tongue. Duval (2006) concurs that another cause for the difficulty of mathematics is using two foreign languages–English and mathematics. The memory of this teacher’s attitude has helped me realise that being approachable and supportive to learners creates a positive learning environment. Consequently, from now onwards, I will plan activities that require learners to interact with each other while constructing knowledge in collaborative groups.

As I am engaged in a self-study research, reflecting on my past learning experiences is a norm (LaBoskey, 2004). Having done that, I am considering being patient with a child who does not want to participate verbally in the class because just like it happened to me, the child might have had similar experiences before. Instead I need to build the child’s confidence by praising every little effort they make. Correspondingly, Jansen (2008) advocates that teachers should be tolerant when they try to win the learners trust so that at the end they come out of their shells of fear and start participating. As a mathematics teacher, winning learners’ trust is important because learners need to be able to interact with the teacher as well as with other learners when learning mathematics. My personal history has made me realise that I have been exercising most of the negative actions that happened to me when I was a learner.

Employing practical based learning

Practical learning is whereby learners learn by doing something or an experiment. Settles (2010) believes that the approach of learning by doing, should be used in science and mathematics subjects. In my personal history in this chapter, I shared, that I was taught by teachers who were using the telling and demonstration methods only. They concentrated on the book or on the board doing sums and did not even notice that some of us slept throughout the lesson. As a learner, I could not understand the lesson and I was confused most of the time.

While introspecting on how I have been teaching, I found that, I too have fallen into this habit of using the demonstration method of teaching with the excuse that my classroom is overcrowded and resources such as books are inadequate or unavailable. This memory makes me realise that my learners will not be able to understand, if I am telling them only or watching me do the patterns for them. Therefore, I must find tools and equipment that will engage learners practically while they learn. In so doing, an improvement in my teaching of patterns, hopefully, will be remarkable.

I had my early learning of counting and patterns at home, which in my view was more meaningful and practical compared to how I learned at school. Before I even entered school, I could count up to ten objects. I counted chickens using attributes of colour and gender. Since the total number of chickens were more than ten, I could not give the total number of chickens. So my mother would ask, “How many hens or how many white chickens?” This memory reveals that I easily learned to count because it was practical. It also tells me that learners already have encountered patterns at home and that I need to capitalise on what they already know and link this to new content.

When planning my lessons, I will concentrate on what learners will do practically and on what I will use as learning aids such as a radio or a video for learners to watch on my laptop. For geometric patterns, I have realised it would be more practical and interesting if I give learners a chance to create the shape cards and ask them if there is any pattern they can make using their cards and then describe their own patterns. This study has made me understand that learners are born curious. Consequently, I can improve my teaching practice by preparing learning activities that will feed the enquiring minds of my learners. I can introduce concrete objects in class for them to solve the mathematical problems practically or exposing them to activities that will interest them such as watching a video to identify patterns or dancing to the music on the radio to find the pattern created by the rhythm.

Incorporating games into my teaching of patterns

As shared in my personal history, before I started school, I had already learned many things through indigenous games such as *umagenda* and (*ugxum gxa*) *hopscotch*. While playing these games, I informally learned counting forward and backward without even knowing numbers. At school, they did not use games to teach us. During breaks at school, we also played these games but in the classroom, we failed to count. This memory alerts me to the idea that as teachers, we sometimes fail to link mathematics with real circumstances and to think of making the learning as fun as possible to learners so that they learn better. Similar to the teachers who taught me, I did not think games could be used as teaching and learning tools for mathematics, until I wrote my personal history. I have only given games to learners such as snakes and ladders and puzzles as a reward for learners who are the first to finish writing and to encourage others to work faster.

Nyota and Mapara (2008) suggest that in Zimbabwe, the Shona tribe's games and plays are recorded and used at schools for learning, in the form of stories, comprehension passages and plays. This means that in Zimbabwe, they have realised the value of including games more especially indigenous games, to the country for learning at schools. By the same token, constructivists hold the belief that play is essential for reasoning and or cognitive growth . For this reason, I plan to include both the outdoor and indoor games as tools of teaching and learning mathematics and other subjects because I now understand that learners are willingly active when playing games and their understanding of what they are learning is guaranteed (Ernest, 1996).

Understanding parental involvement in learners' education

Through my personal history, I was reminded of how involved my father was in my education. He used to be involved in my learning by talking to the teacher to find out how I was doing and that kept me alert in the class. Knowing that my father was around and he could speak to my teachers at any time, helped me strive to be on my teacher's good side at all times. Parental involvement in children's academic lives will close a gap between school and home (LaRocque, Kleiman & Darling, 2011) . Children of involved parents have positive attitudes about school and they take academic achievement as a priority.

Both my parents were not formally educated but they supported me by giving me space to do my schoolwork. They took time to ask me what was happening at school. Their interest in my

schoolwork motivated me. When I got good marks, I knew they were going to applaud me. I need to workshop parents about the help they should be giving their children with their schoolwork. My father encouraged my older siblings to help me with my homework so even if parents are not educated, they must know that, there is something they can do to be involved in children's education. Epstein and Becker (1982); Pomerantz, Moorman and Litwack (2007) concur that when a parent is involved in a child's education, their academic achievement is enhanced.

Furthermore, this memory reminded me that some learners are often absent from school. It might happen that some learners absent themselves without the knowledge of their parents especially when the parents leave early for work and come home late from work. A parent who attends all the parents' meeting is in a position of knowing everything that is happening in the school and in a position of knowing whether the child is always at school or not.

Moving forward, I plan to encourage parents to visit the classroom and inspect their children's work and to communicate with me as a teacher about their children. As a teacher, I must also know the background of the learners such as their socio-economic status and keep the lines of communication open with the parents. For parents that are not able to attend class meetings, I will communicate with them about their children through communication books carried by learners.

Conclusion

In this chapter, I recollected my educational journey. I began with my the informal education I received at home such as learning to count while doing chores and when playing indigenous games. I noticed how informal education at home, can connect with formal education when a child goes to school. I also noticed how games can be integrated into the teaching of patterns. I have come to know that the teaching of patterns can be more effective if it is related to every day examples from the real world.

I provided a narrative of my lived experiences from my childhood to my tertiary education. These experiences have awakened me to the importance of being a kind and approachable educator and how this can help build healthy teaching and learning relationships. I learned how being mean can make learners hate or even fear you which creates an environment not conducive to learning. I highlight the use of collaboration by means of a metaphor drawing

indicating the different types of learning I experienced in grade ten. I close this chapter by illustrating my learning from my tertiary education experiences with a collage.

CHAPTER FOUR

PROCEEDINGS OF IMPLEMENTING NEW STRATEGIES OF TEACHING

Introduction

This self-study focuses on improving my practice in teaching patterns so that learners can identify, extend, describe and create patterns as stipulated in the Curriculum and Assessment Policy Statements (CAPS) (Department of Education (DoE), 2011). In the previous chapter, I visited and examined my personal history to respond to my first research question: *“What can I learn from my personal history about the teaching and learning of patterns?”* I used memory stories, artefacts, and memory drawings to illustrate my personal history. I retrieved both negative and positive memories of my past and I remembered experiences that impacted negatively on the way I have been teaching. The motive for recalling these past experiences was to draw and learn from them, so that I could improve my practice.

In this chapter, I respond to the second research question: *“How can I improve the teaching of patterns to grade two learners?”* I present the data generated by means of the curriculum policy document, lesson plans, examples of learners’ work, my personal journal, learners’ journals, audio-recordings and a collage. When responding to the first question in chapter three, I extracted the following learnings namely: *creating a positive learning environment, parental engagement in their children’s learning, meaningful learning and incorporating games in the learners’ learning.*

Lesson Planning and Reflections

I began my journey of generating data in the second term of the school calendar. To plan my lessons, I had to engage with the Curriculum and Assessment Policy Statements (CAPS), The CAPS document is an official document of the Department of Education that prescribes the curriculum and outlines the annual teaching plans (ATP) for all grades. It also provides lesson plans and the assessments. As a practicing teacher, the CAPS document is the blue print that I am compelled to consult as a frame of reference for my teaching.

According to the CAPS document, grade two learners should be taught three lessons on number patterns and one lesson on geometric patterns in each term. That equals five hours and thirty-

two minutes of total teaching time. Therefore, lessons should be of one hour and twenty-four minutes duration (DoE, 2011). At my school, our time-table is divided into hours, in a cycle of five days (Monday to Friday). Therefore, for day one and two we have a two-hour period per lesson and a one-hour period for days three, four and five. All my lessons were done on two-hour periods. I taught all three lessons on number patterns and the first lesson on geometric patterns in term two. In term three, I taught the second and third lesson on geometric patterns. Table 4.1 illustrates the teaching plan for grade two per period extracted from the CAPS document

Table 4.1 Teaching plan for grade two extracted from the CAPS document (DoE, 2011)

Lesson No	Topic	Sub-Topic	Term & Date
1	Number Patterns	Copy, extend & describe simple number sequencing in 2's from any number up to 150	Term 2
2	Number Patterns	Copy, extend and describe simple number sequencing in 3's and 4's from any number up to 150	Term 2
3	Number Patterns	Copy, extend and describe simple number sequences of 5 from any number up to 150. Creating their own number patterns	Term 2
4	Geometric Patterns	Copy, extend and describe in words patterns using physical objects. Create and describe own patterns.	Term 2
5	Geometric Patterns	Patterns using physical objects that change in a predictable way i.e. by increasing in number and in size	Term 3
6	Geometric Patterns	Identify, describe in words and copy patterns in nature and in modern everyday life. Creating a journal	Term 3

Table 4.1 outlines the lessons that informed my lesson plans that became my data for this study. I sat down and thought about activities that are related to patterns which were going to arouse interest in my learners, considering that learners are going to copy, extend, create and describe patterns as stipulated by the CAPS document (DoE, 2011). In total, six lessons were taught. However, for the purposes of presenting my data, I share the teaching and learning processes

for three lessons because sharing all of them would be impractical, considering that mathematics periods for the foundation phase, are longer as prescribed by the CAPS document, compared to the other phases and each lesson has many activities (DoE, 2011).

As a consequence, for the section on number patterns, I chose lesson three because it included all the skills and concepts that were also part of lessons one and two which were copying, extending and describing patterns. This lesson also introduced a new skill that was creating their own number patterns. In geometric patterns, I also did not share lesson five because it was the continuation of lesson four but I shared lesson six because it concentrated on patterns learners encounter in nature and the lesson focused on getting learners to identify patterns anywhere and give a description of those patterns. The other reason I selected these lessons was that these lessons highlight my learnings that I excavated during this study and from recalling my personal lived experiences. Below is an insert of my journal I wrote after teaching the first and second lesson and before I taught the lesson that follows.

It worries me that most learners are able to count forward but unable to follow the sequence when we do skip counting. For example they can count in fives only if counting starts at 5. If I ask them to start at any number but count in 5's they get confused. This means that they are rote learning and count without meaning. For the next lesson, I need to find activities that will eliminate the reciting behaviour so that they will be able to explain the sequence.

Lesson on number patterns: Counting in 5's **Lesson introduction**

This lesson was on sequencing numbers while counting forward and backward in 5's (adding and subtracting 5). The purpose of the lesson was for learners to copy, identify, extend, describe and create their own patterns using sequences of 5. The introduction of this lesson was influenced by the contributions of my critical friend after I had shared the audio-recording of what I had done in my previous lessons. My critical friend pointed out that I must let learners be involved even during the introduction of the lesson. So, I told my learners to come with me outside so we can play a little game.

Taking them outside was informed by my personal history, where I was reminded of how interested I was when we took educational tours during my teacher training days. Learning outside the class helped me to pay attention in the next class because I could relate what I was

learning in the classroom with what I saw physically on the outside (Brezovszky, Mc Mullen & Veerans, 2019). I wanted to engage my learners in the lesson because all learners enjoy being part of a game. When we arrived outside, I asked them to stand in a circle and count in 3's from 21 to 42 and to count in 4's backwards from 32 to 4. I did that to revise counting in 3's and 4's as they had learned in the previous lesson, and to link the previous lesson with the new lesson.

After drawing a hopscotch grid on a hard surface using chalk, I asked learners if they knew what I had drawn. To my surprise, they all knew the game. They called it (gxum-gxa) which is the IsiZulu word for hopscotch. For this part of the lesson, I wanted to draw from my learning of incorporating games in learners' learning (chapter three). This game is one of the indigenous games that have been played through the generations. Nyota and Mapara (2008) confirm that indigenous games preserve the indigenous knowledge of certain inhabitants of a country. I then asked them to write numbers from 1- 8 inside the squares of the hopscotch grid. The learners wrote numbers and reminded one another of the rules of the game. The rules are provided below:

The first player tosses the stone onto a numbered space of a pattern of squares or rectangles, beginning in the first space. He/she then jumps over to the space where the stone fell and hops onto the next space and continues hopping up to the last space of the hopscotch grid. He/she hops on one foot on one square and then spreads the feet to land on two squares, one foot on each square. He/she comes back hopping onto the same spaces. When he/she reaches the square with the stone, he/she picks it up and finishes the first attempt. The player does the same with the stone tossed on the next space and hopping over the space with a stone once again. If the stone lands on the wrong space, touches the line or bounces out the square/ rectangle, the player is disqualified and the next player plays. The player wins if they finish the whole grid of squares with no mistakes

For the first round, we chose one learner from each group to play. While one player was playing, I asked the other learners to pay attention and look for mistakes and they were counting for the player. Figure: 4.1 below is a photograph of a learner playing hopscotch.



Figure 4.1 Photograph of a learner playing hopscotch

After the chosen learners had played, I erased the numbers and told them we can also use counting in two's or any sequence to play the game. I then asked them to write numbers counting in three's on the hopscotch grid. They helped one another write numbers from three to twenty-four since my hopscotch grid had only eight squares. Then we chose the second players from each group of learners to play hopscotch with the grid in multiples of three.

After the second players from each group had played, I erased the numbers and wrote the number five in the first square at the bottom of the hopscotch grid. I then asked them to add five or count in multiples of five and write the answer on the second square that was ten. All learners were counting using their fingers and they clapped hands when the player landed on the next multiple of five. I noticed they were enjoying the game because it had some rhythm. I let them complete all squares up to the number forty. When they finished, I asked them to count from five to forty and to count backwards from forty to five by subtracting five each time. I then allowed the third learner from each group to play and we agreed that other learners were going to continue with the game during break time so we went back to the classroom.

Most learners could count in fives but from the previous experience I had noticed that they rote learned because when I instructed them to count in fives starting from a random number such as three, they did not know that they should add five each time, so they ended up counting in 3's. By allowing them to add five, I wanted them to capture the rule of adding the given number when counting forward or subtracting the number when counting backward. By engaging them

in a play learning activity, I was able to help them develop skills and knowledge that are vital for future learning (Ceglowski, 1997).

Content delivery

Back in the classroom, I wanted to connect what we did outside with the new content. I gave each learner some paper and asked them to quickly draw a hopscotch grid and fill in numbers from five to forty just as the one we did outside. I observed that none of them had a problem with this because they remembered what we did while we were outside. They were all interested and they finished as fast as they could. I then requested them to count the number of squares on the hopscotch grid. Figure 4.2 is an example of a learner's drawing of the hopscotch grid.

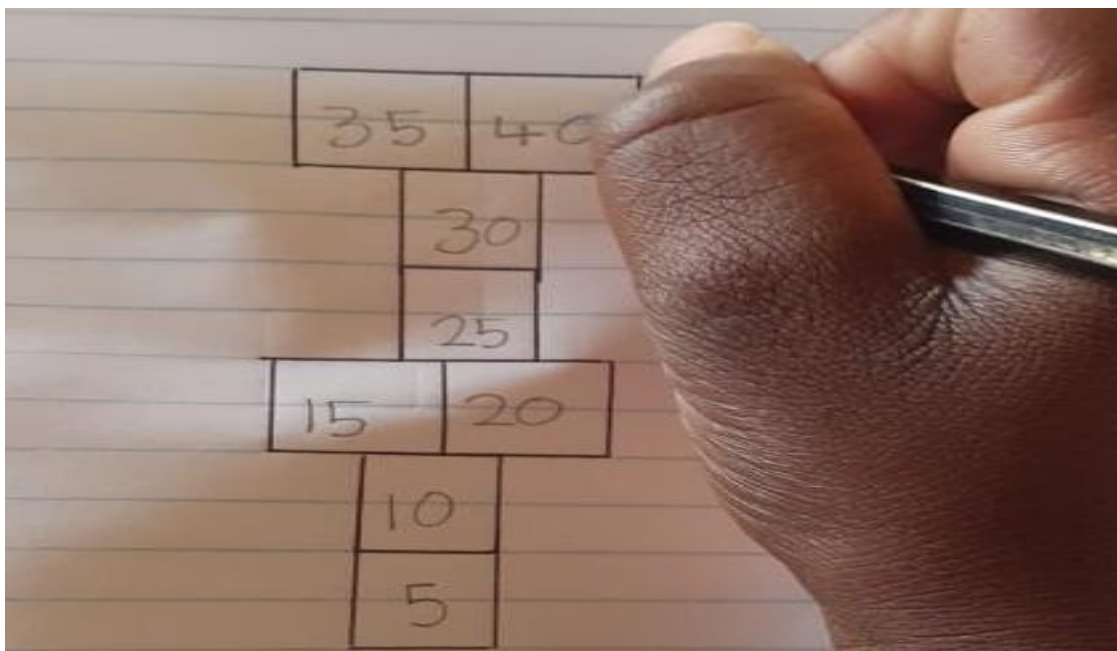


Figure 4.2 Learner's drawing of the hopscotch grid

To continue with the lesson, I told them I was going to draw the same number of squares on the board but in a straight line and they must tell me which numbers to write in the same sequence as in their hopscotch grid. There were eight squares in their drawing so I added three empty squares at the end of my drawing for them to extend the pattern. I then wrote the numbers in each square as they counted the squares. I explained to them that we call each sequence in a

pattern, a term. Figure 4.3 below is a photograph of the extended hopscotch grid I did on the board

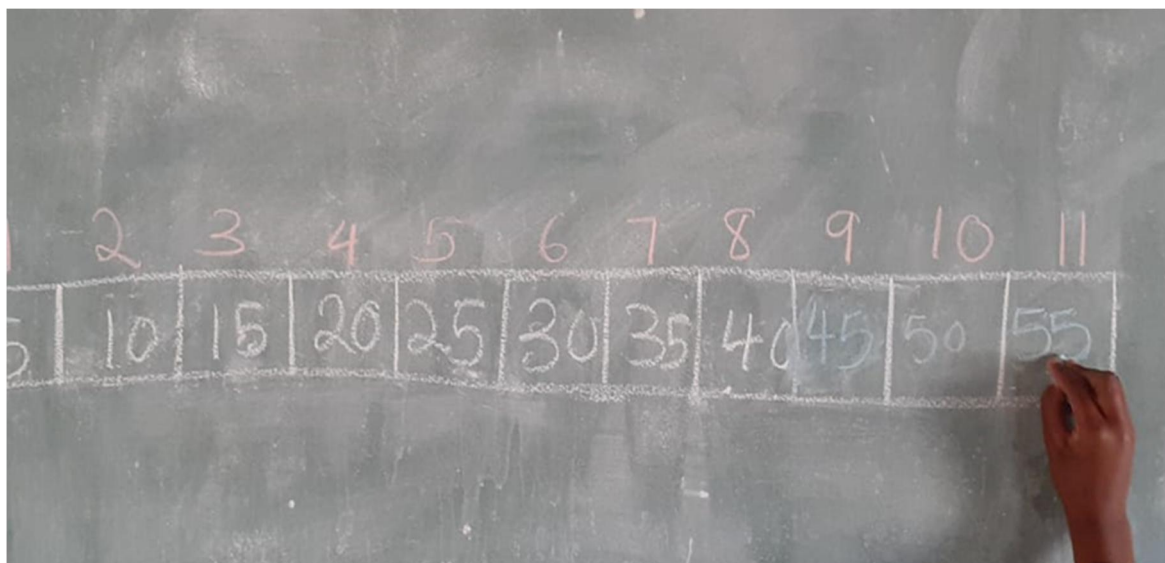


Figure 4.3 Photograph of the extended hopscotch grid I did on the board

For the entire class activity, I started by asking one learner to come and complete (extend) the pattern by writing numbers that should be on terms 9, 10 and 11. All learners raised their hands which indicated to me they could count in 5's. I asked them the following questions based on the drawing that I did on the board.

Teacher: What is the pattern rule? What did you do to find the missing numbers in terms 9, 10 and 11? (I probed.)

Toti: We add 5

Teacher: Very well done, so the rule of the above pattern is add 5 each time.

I then asked them to look at the ones or units digits on the board. I wanted them to tell me the pattern that they could see. They seemed to be confused which indicated to me that they did not understand. I then wrote the number 27 on the far side of the board and asked them which digit represents the ones and which digit stands for the tens. This would help me when I teach them to recognise patterns made by the first digits and last digits in a number. All of them remembered what I meant about ones and tens from when we learned about place values. I chose one learner to come and point at the ones as the whole class called out the answer so everyone could see the answer as indicated below:

Sinaye: 5, 0, 5, 0, 5, 0, 5, 0, 5, 0, 5

I rewarded Sinaye with a gold star on his forehead and asked other learners to give him a round of applause. I wanted them to see the commonality or pattern here and that is that all numbers end with either a five or a zero. I then asked them to look at the digits of tens and asked them to tell me the pattern they could see. I also told them to remember that I did not want them to only tell us what they did, but also explain why they did that as illustrated below:

To which they responded, 1, 1, 2, 2, 3, 3, 4, 4, 5, 5

For the above activity I wanted to embed the idea that one pattern can produce many patterns. As an example in a pattern of counting in fives, other patterns of ones and tens emerged. I also wanted them to physically see what a number pattern is about and what is common in a sequence of numbers so that when they describe a pattern or make a rule of a pattern, they look for that commonality first and be able to explain in a simple form, how the commonality is created.

I found that praising learners each time they made an effort to answer or do something right, helps to maintain a friendly learning atmosphere and serves as motivation for learners to participate and excel (Zazkis & Liljedahk, 2002). My learning of creating a positive learning environment for learners from my personal history (see chapter three) informed me about creating appositve learning environment. Praising learners also encourages other learners to participate because they all want to be acknowledged.

After this whole class activity, I arranged learners to sit in groups because I wanted to give them an activity to discuss and solve problems collaboratively. I then gave them worksheets to work on as groups. I read the questions and explained each question. The worksheet comprised of two questions. The first question was slightly different because the pattern started with a random number (57), which is not a multiple of five. This was to make them realise that they could count in fives even when not using the multiples of five.

The second question on the worksheet allowed them to think creatively while solving a problem when sharing sweets among a given number of children. Working on the problem as given in the second question, would lead them to creating their own pattern of counting in five's. Figure 4.4 is an example of the worksheet given to learners to work on in groups.

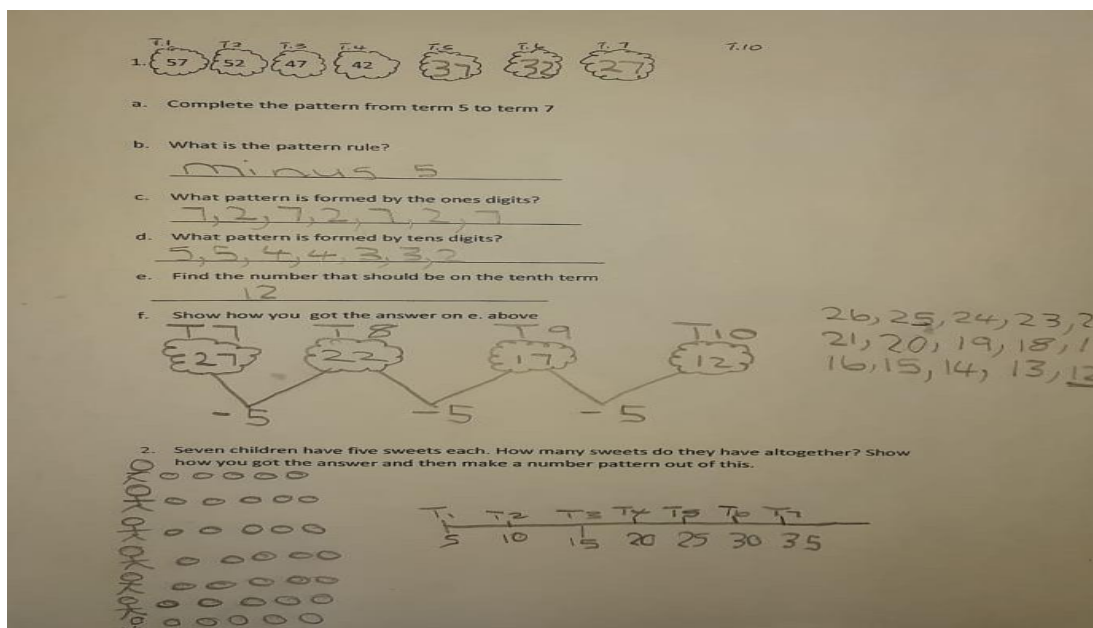


Figure 4.4 Worksheet given to learners to work on in groups

As I walked from one group to the other, I could see that even shy learners participated and were able to ask for clarification from others and from me. Drawing from my personal history, I was reminded of my grade ten experience of group work where we got a chance to use isiZulu to help each other understand the formulae. Using collaboration allowed learners to assist one another during discussion of the questions as they exchanged knowledge and ideas. Similarly, Tolmie et al. (2010), agree that learners work much better when they work together.

I noticed that most groups decided to draw seven children and five sweets per child. They showed how they counted in five's to get the total number of sweets. This told me that I should consider using more drawings and real objects because they understand that better. Some groups came up with repeated addition of fives and others even came up with multiplication number sentence ($7 \times 5 = 35$). Letting them work in groups helped them to learn from one another, hence exercising the zone of proximal development (ZPD) which simply means their cognitive levels were positively affected by their surroundings, their group mates in this regard (Matlala, 2015). I appreciated each group even if some of them miscalculated and got wrong answers because I was happy with the correct methods they used.

Giving different answers showed me that learners understood that they were allowed to give their own meaning of the content and that they were able to understand and solve mathematical problems. This is in line with Callejo and Zapatera (2017) who articulate that “the teacher’s

skill in noticing student mathematical thinking demands more than just pointing out what is correct or incorrect about their answers, but requires determining in what way students' answers are or not meaningful from a mathematical learning stand point" (p. 2).

Inevitably, this lesson assured me that the hopscotch game we played was educative because rote-learning was discouraged when they found the next number by adding and subtracting while filling numbers in the hopscotch grid. Ceglowski (1997); Mayer (2002) concurs by suggesting that teachers should take play seriously making sure that it should both be playful and educative. This means that playing a game as part of my teaching number patterns was beneficial because they were attentive and they understood how to arrive at the next number.

Consolidation/ Conclusion

When all the groups finished, I asked each group to give their answers they wrote in their worksheets, to the whole class and when we finished I gave learners homework. Their homework was to go home and draw their hopscotch grid on the ground in their yards and write numbers in multiples of five's from 50 to 100. I told them to play hopscotch with their siblings and when they are done playing, they should draw the same hopscotch grid in their exercise books with the same numbers. I wanted learners to carry on counting in multiples of five up to a 100. I wanted them to remember how we skip counted when we wrote numbers on a hopscotch grid and I had noticed that they counted more accurately during the game than when they recited times-table prior to me embarking on this self-study.

Learners' reflections

Looking at learner's journals, I saw that learners were happy about the lesson and they enjoyed the indigenous game they played. They drew the happy face emoticons and they wrote that they enjoyed the game. Their journal reflections showed me that incorporating games in the lesson excited them and captured their attention. Figure 4.5 is an example of a learner's reflection on the lesson in the learner's journal.

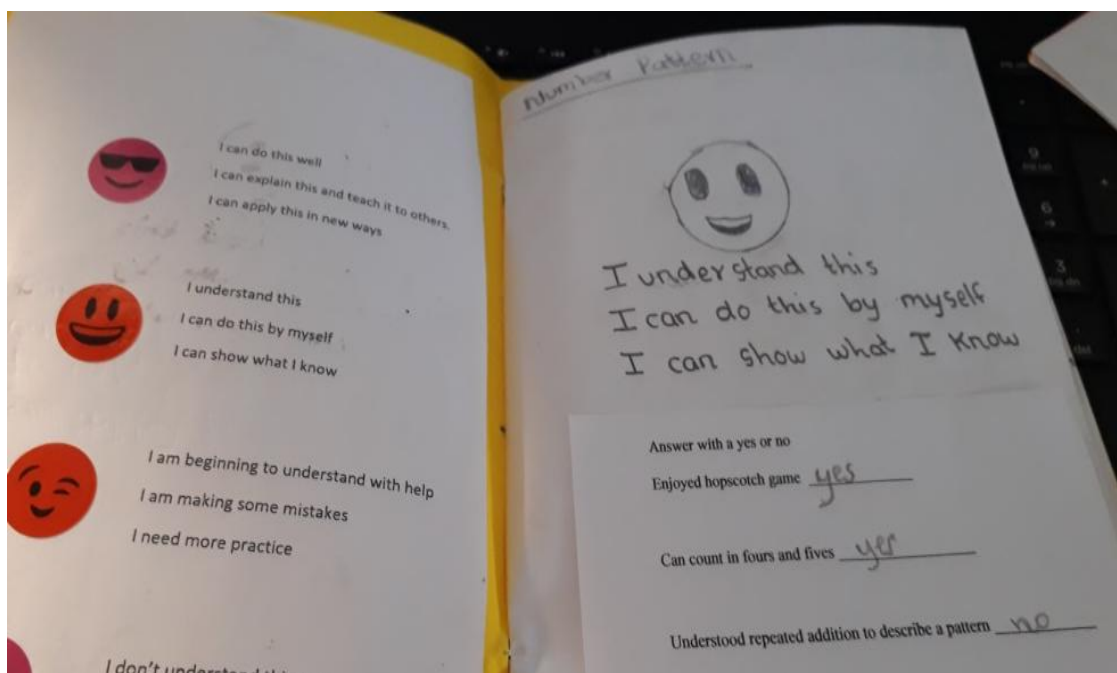


Figure 4.5 Learner's reflection on the lesson in the learner's journal

My observation and reflection on the lesson

Commencing from the introduction, I observed that learners were very happy when they played hopscotch. I noticed much enthusiasm and energy oozing from each one of them including those I thought would not want to participate. My critical friend's idea of letting them be active right from the beginning worked very well because I noticed that when I asked them to come with me outside, their curiosity was stirred because when the learning started, they were ready and willing to be involved in the game. Although time did not allow all to participate to take part in the game, they all enjoyed being referees and setting the rules of the game. The game helped them to understand the sequence of counting in five's and describing the pattern. When I changed from counting in one's, three's and four's to counting in five's, they easily moved with me and they participated throughout because it was still the same game. I learned that teaching number patterns and skip counting should be made practical and include games because this encouraged learners to be involved and attentive.

When we went back to the classroom they all were interested to draw the hopscotch grid on paper. They listened and participated in all the activities including the homework because it was about playing the game. Some learners were able to use prior knowledge of sharing and grouping to solve the problem sum so that they could create their own pattern. Others used a

number line which was good because it showed that they were able to draw from their existing knowledge to construct new knowledge. I was happy with this improvement in my teaching method which was reflected by their understanding of patterns. Learners were able to extend, describe simple number sequences and they were also able to create their own patterns as required by the CAPS document (DBE, 2011). This showed me that learners learn better when they are involved in the lesson especially when they play games. As a mathematics teacher I learnt that when I plan activities, I should think about what learners will do during the lesson not just what they will say.

Lesson on Geometric increasing patterns

This lesson was on geometric increasing patterns where according to the Caps document, grade two learners are expected to copy, extend, create and describe own geometric patterns with physical objects (DBE, 2011). I engaged learners in practical activities where they created the physical objects in the form of two-dimension shape cards. My aim was to let them revise repeated patterns and then create increasing geometric patterns. This lesson was informed by my second learning from my personal history: *employing practical based learning*. I realised that I had always limited learners' practical engagement in a lesson because I relied on activities from certain books that did not include the activities the learners were expected to complete, in order to achieve the requisite outcomes.

Lesson Introduction

I began the lesson by revising the two-dimensional shapes since they were going to use them for this lesson. Learners had learned in the first term, about the four types of 2 D shapes, normally called 2Ds. Continuing with incorporating games in learning, I gave each group a word puzzle. In the word puzzle, there were names of the shapes they learnt from the Space and Shapes content area in the CAPS document (DBE, 2011) Umugiraneza, Bansilal, and North (2017) accord that teachers who integrate topics across the content areas of mathematics could improve learners' understanding of mathematics. I found the puzzle to be an educative game for learners because as they were looking for the names of the shapes, they were reminded of the names of 2 D shapes as well as their spelling. While they were identifying the shapes in the puzzle, I asked them to colour the words (names of the shapes) as they found them. After colouring the words, I asked them to draw the shapes they found in a space below the puzzle and write the name of the shapes near the drawings.

Learners identified all the shapes inside the puzzle. I reflected that if I had asked them to tell it to me they would have not remembered them but because there was play involved, they were all keen to find the words. I found that when expatiating about including games in mathematics teaching, Ernest (1986) asserts that “pupils become strongly motivated, they immerse themselves in the activity” (p. 3). Learners demonstrated that they still remembered all four shapes (as grade two only learn four) when they drew and labelled them correctly. Figure 4.6 is an example of the word puzzle containing the names of 2 D shapes,

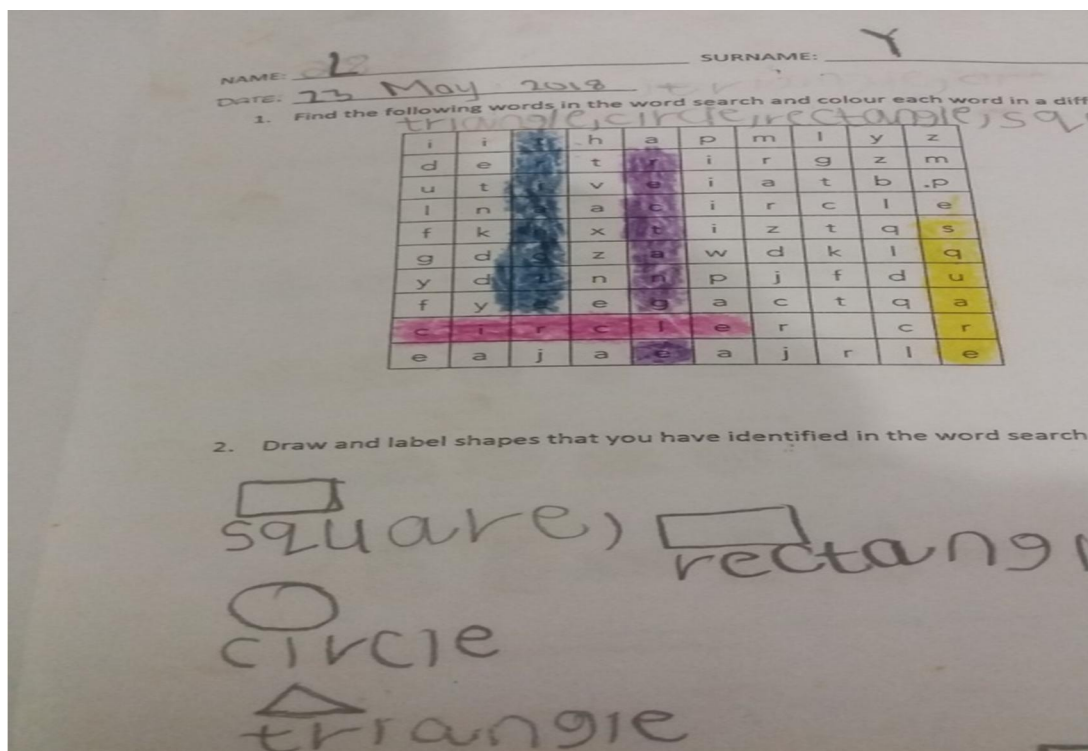


Figure 4.6 Example of the word puzzle containing the names of 2 D shapes

Content Delivery

After reminding the learners of the shapes as well as their names, I then gave them some A4 papers to make shapes to use as their learning materials. They were going to work as groups and divided the task amongst the whole class so that all learners were involved and categorised them as:

Group 1 Make 4 different sizes of circles.

Group 2 Make 4 different sizes of squares.

Group 3 Make 4 different sizes of triangles.

Group 4 Make 4 different sizes of rectangles.

Group 5 Colour circles and squares.

Group 6 Colour triangles and rectangles.

They were all going to use green, blue, red and purple colours because I wanted to include an attribute of colour in the patterns. I was surprised to learn that all learners were busy doing their tasks and there was no noise in the classroom. Figure 4.7 is a photograph of learners working on their 2D shapes.



Figure 4.7 Photograph of learners working on their 2D shapes

All learners were quietly busy and I was walking around from group to group, making sure that they all had enough cutting and colouring materials. I also made sure that they were not fighting over things or putting themselves in danger since they were using scissors. When they finished, they brought the shape card to my table. I divided the shape cards amongst all groups so that each group had all four shapes. I told them to create any pattern using their shape cards. Learners had done repeated patterns in the first term. I wanted to revise this and to link the previous lesson with the new lesson. Some made their patterns in different colours while others created them using different shapes following a certain pattern. This showed me that they still remembered the section on patterns they did in the first term. Figure 4.8 is an example of “a pattern of one rectangle and one circle” created by a learner.



Figure 4.8 Example of “a pattern of one rectangle and one circle” created by a learner.

To consolidate what the learners did, I also drew a repeating pattern on the board. Figure 4.9 is the pattern I drew on the board.

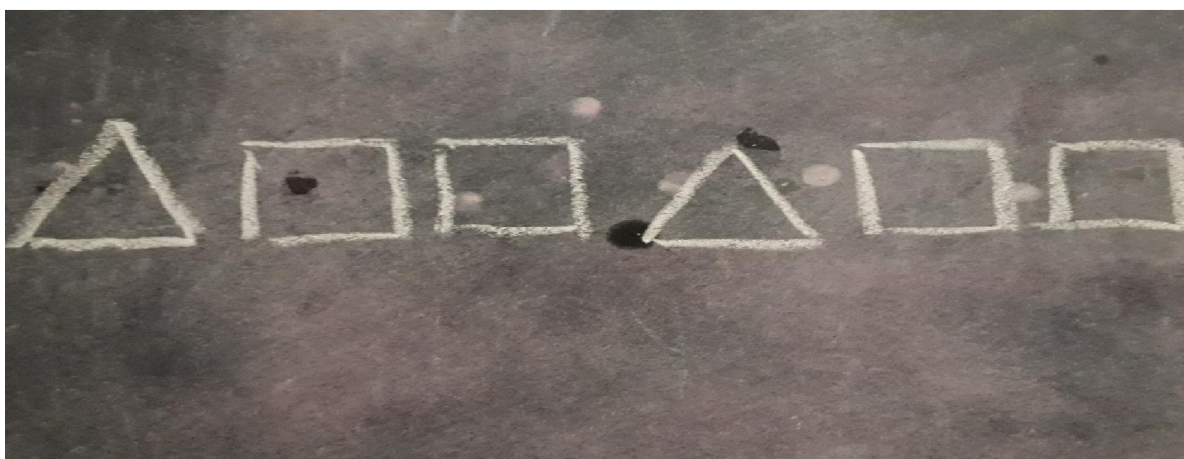


Figure 4.9 Pattern of ‘one triangle, two squares’ that I drew on the board

I then asked them what my next term of pattern would be. They told me that one triangle and two squares. Thereafter, I asked them the following questions

Teacher: What pattern do you see on the board?

Thato: A pattern of one triangle and two squares.

Teacher: Very good Thato

It was then that I explained that the pattern on the board and the pattern they made are called repeating patterns because the same elements are repeated in each term. I then took some shape cards from them and formed another pattern on the board and asked them to study the pattern. With the pattern I made, I wanted to introduce them to increasing patterns using the shape cards they made as real objects. Figure 4.10 is the increasing pattern I drew on the board.

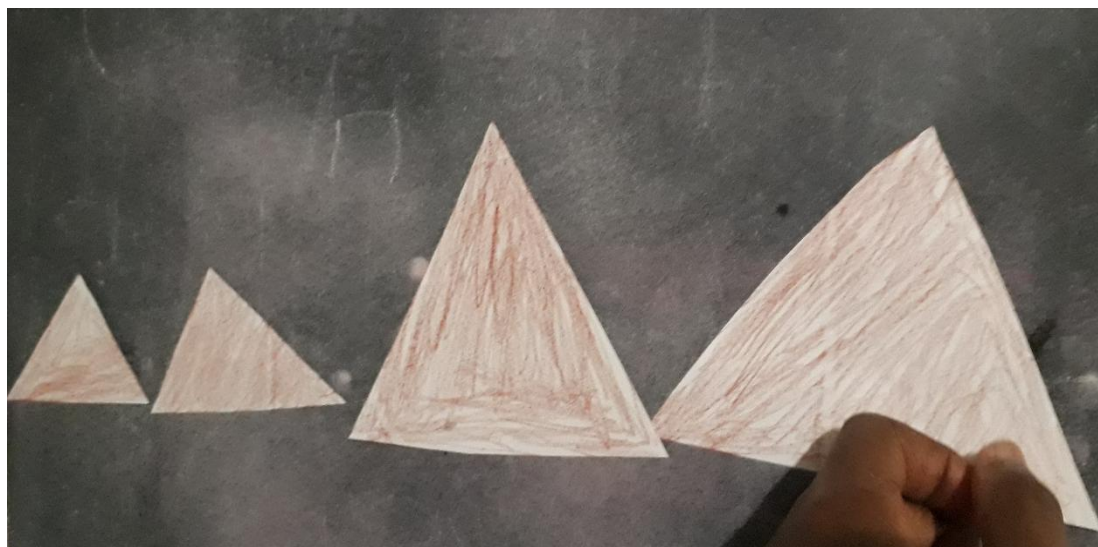


Figure 4.10 Increasing pattern I made on the board

I explained to the learners that instead of repeating in each term, the pattern is increasing. I wanted them to know the mathematical term ‘increasing’ so that they got used to it. I further explained that an increasing pattern is a growing pattern or a pattern that gets bigger and bigger each time. To make them understand the term, I showed them using my hands. For the word increasing, I opened my two hands moving them away from each other. I did this to make sure that learners understood my explanation of the word increasing. Language is sometimes a problem, so I used my hands to explain increasing so that learners would get the meaning. Adler et al. (1992) pointed out that “many teachers held that learning mathematics in school in a language that is neither the teacher’s nor pupils’ main language, places additional and complex demands on teachers and learners” (p. 25). This means that when teaching mathematics, teachers also face language problem which slows down our mathematics teaching as we stop and teach vocabulary, spelling and meaning of words. I wrote the word on the board and I asked the following questions:

Teacher: Complete this statement: “Increasing pattern means that the pattern gets bigger and _____?”

Khetha: bigger

Teacher: Does the pattern on the board increase in size or in number?

Thato: Size

Teacher: Excellent

I was convinced that most learners understood that the geometric pattern increases in size because most of the hands were up when I asked questions. I formed my own pattern on the board that was slightly different to the pattern I drew above and asked them to study it and describe it. Figure 4.11 is the pattern I created on the board.



Figure 4.11 Pattern I created on the board to show increasing patterns

I asked learners the following questions:

Teacher: What shapes do you see in my pattern?

Learners: Circles

Teacher: What can you say about the size of all the circles? (I decided to use this higher order question for them because they I wanted them to think creatively and reveal their ideas and understanding when answering this question)

Sipho: Circles are small

Teacher: Good Sipho. Does the size of the circle increase in each term or same in each term?

Swazi: Increase

Teacher: Good. So how can we describe this pattern?

Amanda: It is 1, 2, 3 circles

Teacher: A good try. Yes. Is the pattern increasing Amanda?

Amanda: Yes teacher

Teacher: Good. Since the size of the circles is the same, how is the pattern increasing?

Learners: No answer

Teacher: Do the shapes increase in size or in number? (I explained my question further because learners did not understand how the pattern increased)

Learner: in number (they all shouted the answer).

Teacher: Excellent. The pattern is increasing in number. So increasing patterns can either increase by size or by _____.

Learners: Number

This cautioned me that learners failed to see the relationship between number patterns and geometric patterns because they could not see the increase in number. I had to ask a probing question as a scaffolding means from my part, to assist them to answer a question slightly above their level. At the end of the lesson, I asked learners to take out their classwork books and draw their own increasing patterns and write down the description on whether the pattern was increasing in size or in number. Figure 4.12 below shows that they created a 'growing in number pattern' by themselves, so my guidance positively affected their zone of next/ proximal development (Taber, 2011).

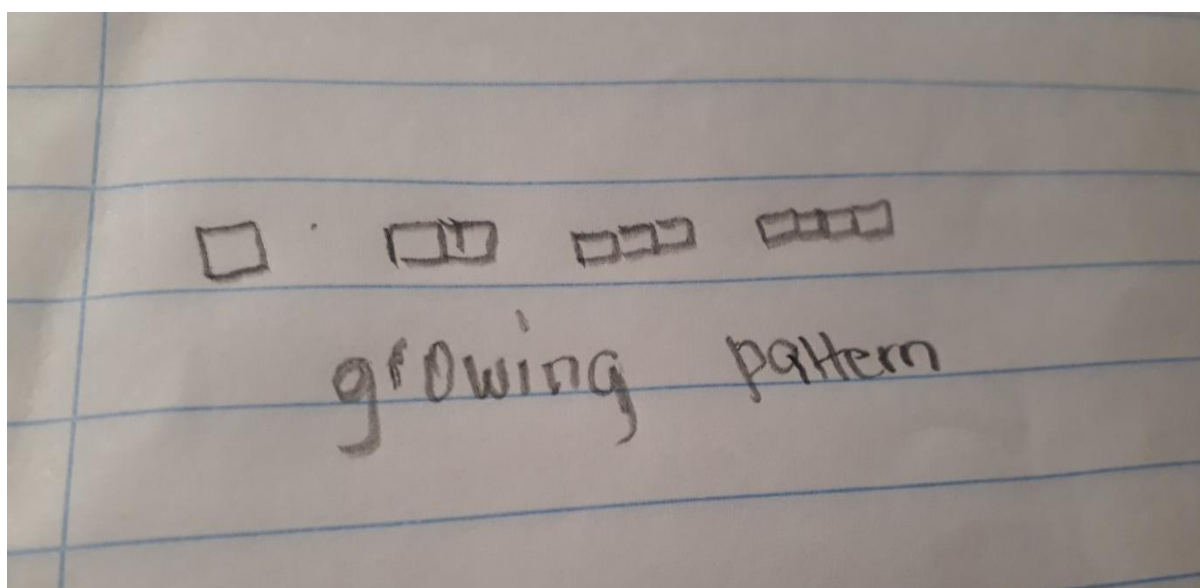


Figure 4.12 Example of learner's pattern growing in number

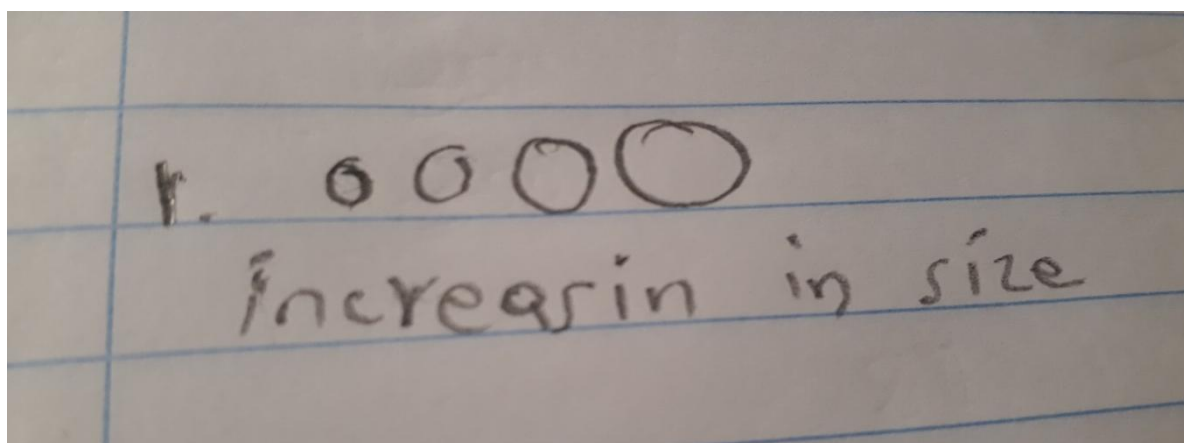


Figure 4.13 Example of learner's pattern growing in size

Consolidation/ Conclusion

As part of consolidating the lesson, I gave learners homework. Learners were given worksheets to complete. I explained each question to them where they had to complete repeating and increasing patterns by drawing the next pattern. Then I expected them to state whether the pattern was increasing in number or size. Figure 4.14 is an example of a learner's homework

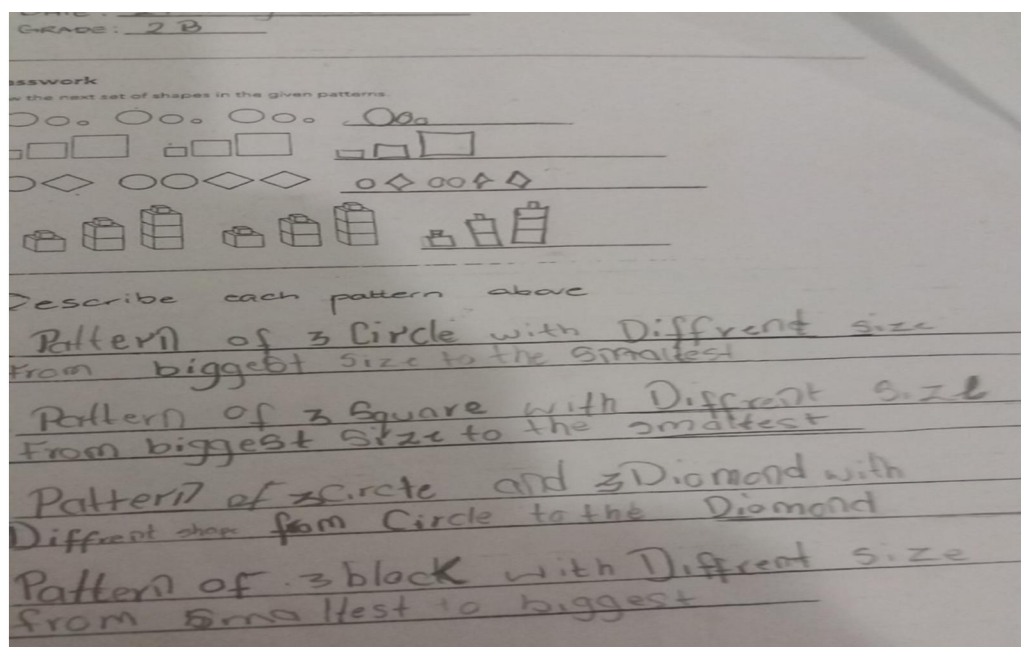


Figure 4.14 Example of a learner's homework

After marking their homework the following day, I found that almost all learners described the first and second pattern the same way using the words ‘smallest to biggest’ where the pattern increases. This showed that learners have begun to solve mathematical problems the way they understand using the terms they are comfortable with. Understanding is displayed when they can use their own words to describe the pattern (Kwan & Wong, 2014). Instead of saying the pattern increased in size (as they learned in the class), the learner wrote that the shape size is from smallest to biggest as indicated in Figure 4.14.

My reflection on the lesson

The lesson went well even though there were some new difficult terms for them such as ‘increasing’ to deal with. However, using shape cards that they had created to show increasing in size and in number, helped them construct the meaning of the word in their minds. When I demonstrated with body language and explained the word increasing, I reinforced understanding of the word. Learners understood what the term meant as they were able to use their own words instead. When they described increasing patterns, some of them used the word growing, others described the change of pattern as moving from smallest to biggest. This showed me that for learners to be able to describe patterns, I should let them be active in creating the pattern and using physical objects to create patterns because this made the pattern more visible.

Additionally, letting learners cut and create shapes that they were going to use when making patterns, helped them understand that they could make patterns using different attributes such as colour, size and number and that patterns can be made by anyone, as they did. I learned from this lesson that when I allow learners to learn by doing practically and use physical objects to create something, they use the same thoughts they had when they created it, to make meaning. In this regard, learners were able to create and describe their own increasing patterns.

According to Zazkis and Liljedahl (2002), realising and completing the given pattern is the easiest part but describing a pattern is a bit abstract, so letting learners create their own patterns helped them to describe patterns because it made them realise that the key to describing a pattern is to understand how the pattern is created. Hence, when I made a pattern on the board, they first sought to understand how my pattern was created, then they were able to describe it.

Additionally, Education (2012) is convinced that “the brain is a pattern seeker, so the development of students’ abilities to recognize, analyse and generally become proficient

pattern seekers will not only pave the way for their success in mathematics, but in all learning” (p. 5). So, teaching learners to identify and describe patterns is in turn teaching them to manipulate and examine given information in all spheres of learning. This lesson made me see the importance of teaching patterns as they teach learners to be creative and become problem solvers which is an outcome needed even when furthering their studies.

Lesson on patterns in nature

Lesson Introduction

In preparation for this lesson on patterns in nature, I had asked learners to collect pictures where they saw a pattern of some sort whether it was for bedding, mats, dresses, animals and others. I wrote a letter to my learners’ parents asking them to help their children find old magazines from libraries and from shops who give away the old magazines or sold them cheaply. I explained to them what the children needed from the magazines. I understood this as important, as suggested by the learning from my personal history experiences: *involving parents in learners’ learning (see chapter 3)*.

Since I knew the socio-economic background of most learners was not good, accessing magazines would not be easy and I knew that learners could not get the pictures without the help of their parents so involving them would make their learning a success (Menheere & Hooze, 2010). For those who did not manage to get pictures, I had kept a few magazines for them in my cabinet, so I gave it to them and let them find pictures that had a pattern of some kind. Learners were excited to take their pictures out but I asked them to keep the pictures as we were going to use them later.

To begin the lesson, I created a chart in the form of a poster showing different animals including domesticated and wild animals, which captured their attention and interest. I then asked them to name the animals as I pointed to the pictures with flashcards that I had placed on the desk in the front of the classroom with the names of the animals. Figure 4.15 is a photograph of a learner selecting a flashcard



Figure 4.15 Photograph of a learner selecting a relevant flashcard to create a pattern using animals' names

If the learner knew the type of animal; they would go to the desk in front and pick the correct flashcard with the type of animal and paste the flashcard on top of the relevant picture. In mathematics teaching, we use flash-cards (number builders) or number cards extensively but using flashcards integrates mathematics and language. An et al. (2013), stress that the integration of subjects has a remarkable impact on learning because it helps learners to see learning holistically. It also helps them improve their English which is their second language. Similarly, Christiansen (2007); Motshekga (2010) emphasise the need for learners to improve their reading and counting skills as well. When all the types of animals were identified, I removed all the flashcards from the pictures of the animals and put them back on the table. My next question was to ask learners to make a pattern of wild animals using the flash cards. Since they were able to create patterns using the shape cards they created in the previous lesson on geometric patterns, I wanted them to identify and create patterns that are naturally made by God and to fulfil the outcomes as stated in the CAPS document that they should be able to identify patterns in nature. They raised their hands and I pointed at each learner to come and paste the flashcards with wild animals' names forming a straight line. Then they also had to make another pattern of domesticated animals. Figure 4.16 is an example of a learner making a pattern of wild and domesticated animals using the flashcards.

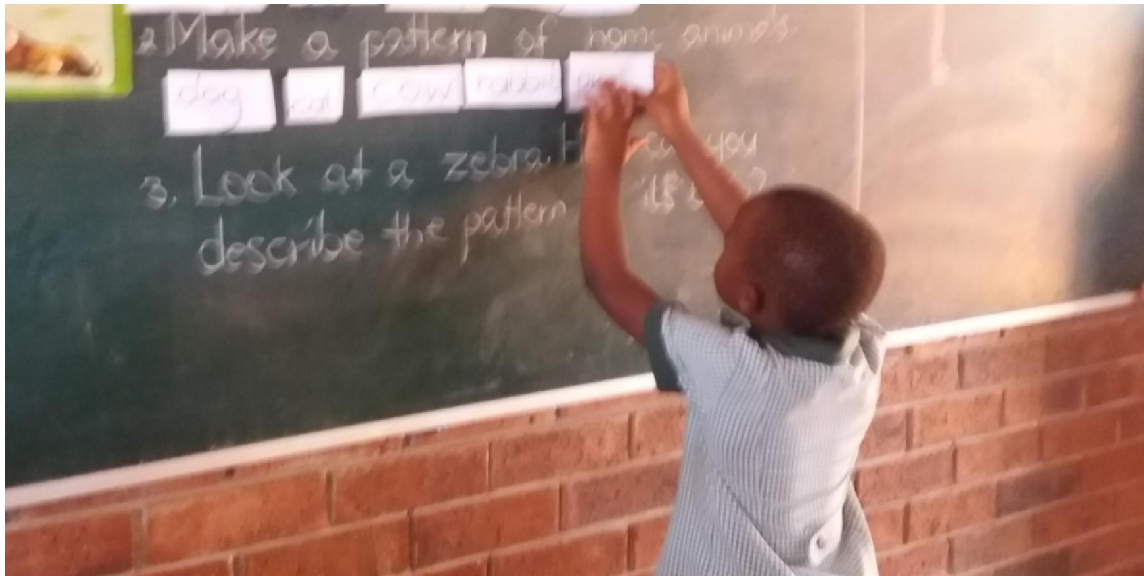


Figure 4.16 Example of a learner making a pattern of wild and domesticated animals using the flashcards.

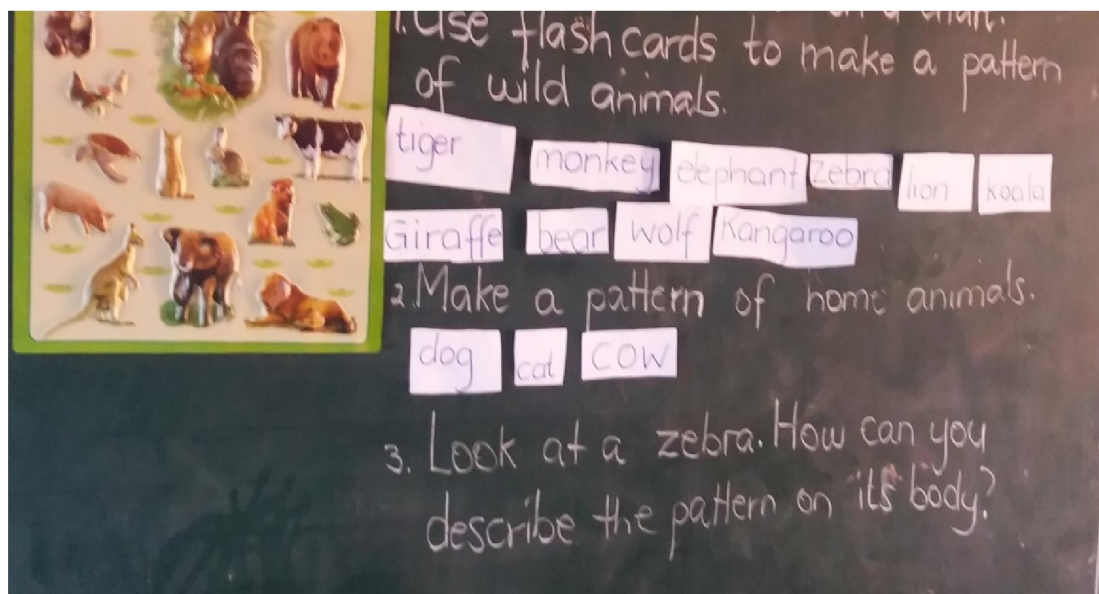


Figure 4.17 Patterns made by learners using flashcards with animals' names

Content delivery

In preparation for this lesson, I had downloaded a video showing wild animals, giving learners the opportunity to physically recognise the different prints on different animals' skins and to let them identify and describe patterns made of shapes and colours on the animal prints. I used my laptop for learners to watch the video because there was no television at the school. I had to improvise for my lesson to be a success and for my learners to enjoy the lesson since I have

come to know that learners understand the lesson that they enjoy. I brought learners to the front of the classroom and I played the video for all to watch. Figure 4.18 is an image of black and white striped pattern on a zebra. As they were watching, I paused the video to show them the zebra and asked them the following questions:

Teacher: Can you describe the pattern you see on the body of the zebra?

Ayanda: Black and white colour

Teacher: Good. What else can we say when we describe the body of the zebra?

Esethu: Black and white lines

Teacher: Very Good. We see a pattern of black and white lines or stripes down its body.

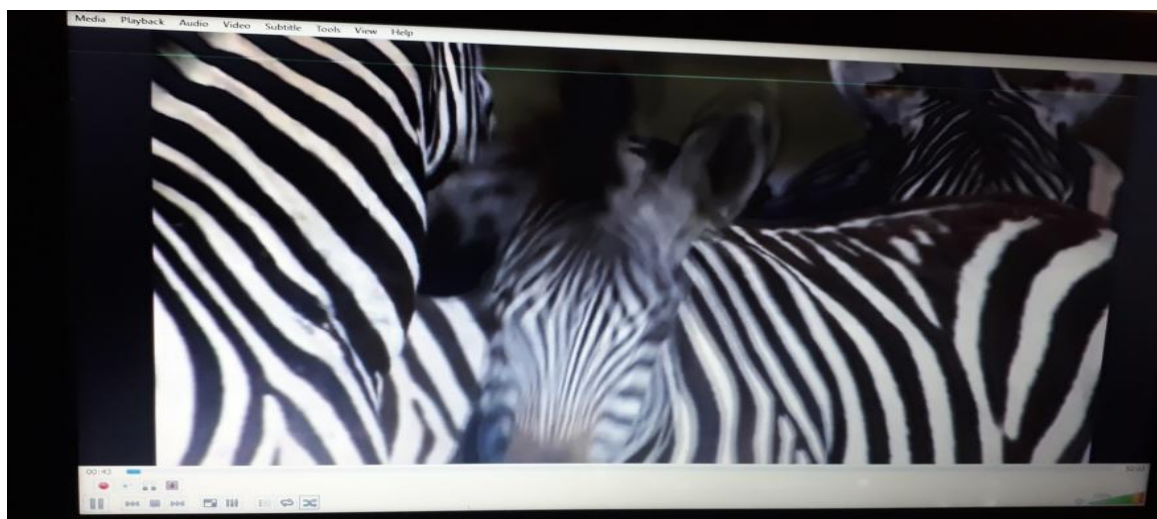


Figure 4.18 Image showing black and white striped pattern on a zebra (patterns in nature)

I then played the video until I paused on the giraffe eating leaves on tall trees. I asked almost the same questions and played on and paused on the leopard. Learners described the squared brown spots on the giraffe as well as the black, circled spots on the leopard's body. I came to understand that the use of multimedia such as video where learners watch and listen, capture their interest. Learners were both attentive and focused (Bhatti et al., 2017).

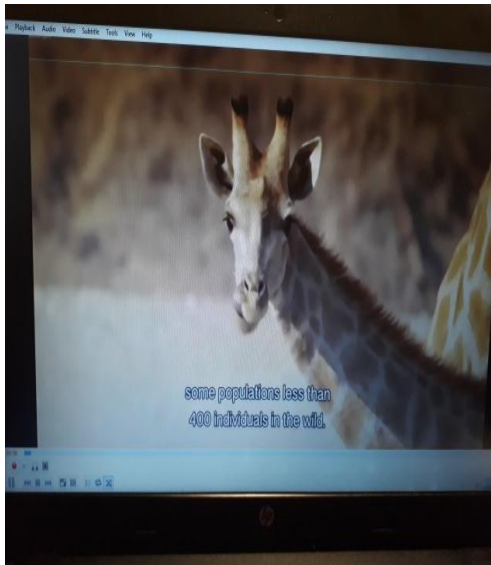


Figure 4.19 An image of a zebra taken during the video playing)

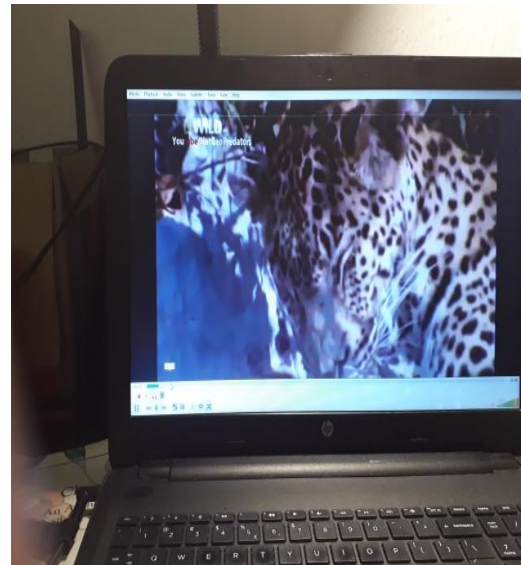


Figure 4.20 An image of a leopard (screenshots

The aim of the lesson was to identify and describe patterns in nature, When we were done watching the video, the learners went back to sit in their respective groups. I then gave a chart to each group and told them that we were going to make a pattern collage using the pictures they collected over the weekend. My aim of using a collage was to summarise the patterns learning since this was the last lesson on patterns. I knew that if learners were able to bring relevant pictures and were able to describe the patterns they came up with, it would mean that they understood patterns well. Using different multimedia for teaching such as physical objects and the laptop and videos, enhanced my lessons because learners were very excited every time I introduced new resources (Blank, Porter & Smithson, 2001).

I reminded them that we were going to choose the best collage and display it on the wall. The groups took out their pictures, chose the relevant ones, and pasted them on their chart. Figure 4.21 shows learners pasting their pictures on the chart paper to construct a collage.



Figure 4.21 Learners pasting pictures on chart paper to create a collage

I was impressed observing them discussing and making informed decisions like adults. I think they were getting used to working together and I was reminded of what Hadebe-Ndlovu (2016) said, that mathematics teachers should use approaches that engage learners in doing practical activities in small groups so that co-operative learning is enhanced. Similarly, in my class, I have allowed learners to work in small groups, deciding on which pictures reflect patterns and pasting them on their chart. This has taught me that when I plan activities, I must plan more practical activities and use physical objects that learners can create themselves. When learners were finished with their collages, I put each collage up on the wall of the classroom and made them select the best one. They all agreed that the collage from group two was the most eye-catching collage. I stuck this collage on the board with pre-stick for all to see and also we were going to use this collage later. I then pasted all the collages on the wall at the back of the classroom.

For the last part of the lesson, I wanted to emphasise that patterns are found everywhere and I wanted them to identify patterns on different objects and say what attributes they could use to describe those patterns. Attributes are like characteristics we use to describe objects or even people. I then showed them four flashcards with four different words about attributes namely colour, shape, size and number that they could use to describe patterns they identified on the collage. I put the flashcards on the table and explained that they should look for a pattern and come and take a flashcard to match the pattern on the collage. The chosen learner would first point at the picture where they see a pattern. Thereafter, that learner would come and take a

flashcard with the attribute they can use to describe that particular pattern and paste it on the relevant picture. Figure 4.22 is that of a learner pasting the flashcard of an attribute to describe the pattern on the picture in the collage that learners selected as the most eye-catching.



Figure 4.22 Learner pasting a flashcard of an attribute to describe the pattern on the picture, in the collage that learners selected as the most eye-catching

Consolidation/ Conclusion

Since time was against us, the worksheets that were supposed to be done in class were given to learners to do as homework. I explained to them that for the first question, they were going to match the animal print to the correct animal and for the second question they were supposed to describe the patterns using the given keywords. While marking the worksheets the next day, I noticed that all learners got the first and second answers correct which shows that the new methods I used made a remarkable difference because they did not use the keywords given to them to describe the patterns, but they used their own words. This was indicative that their learning had moved from rote learning to meaningful learning and I think this showed that they understood patterns and that my teaching of patterns had improved. The images below from Figure 4.23 to Figure 4.26 are examples of different learner's homework.

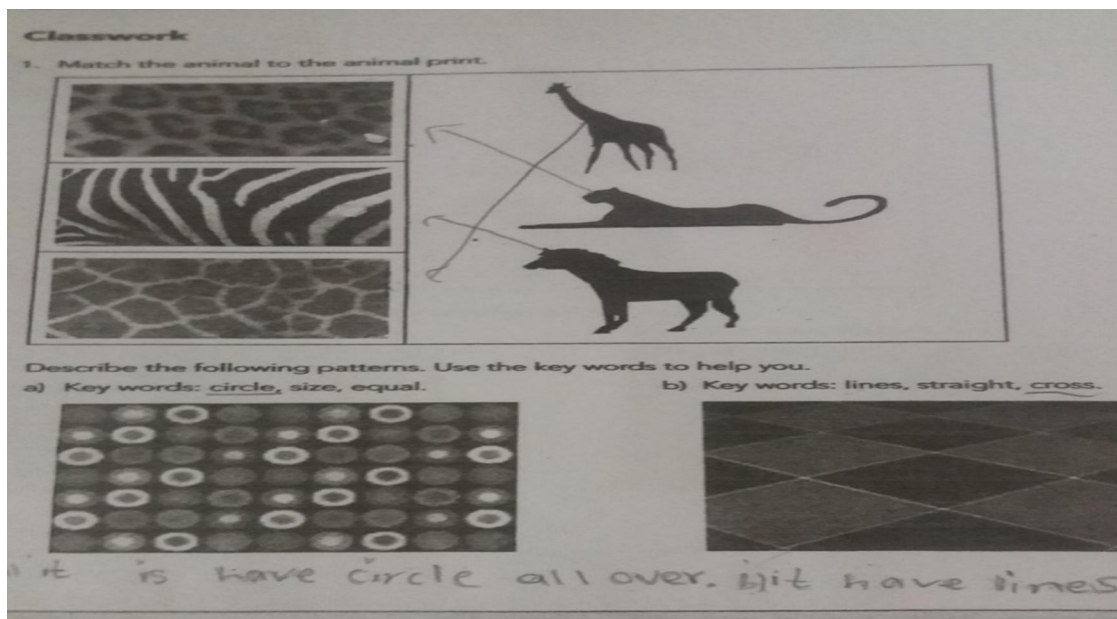


Figure 4.23 example 1 of the learners' homework

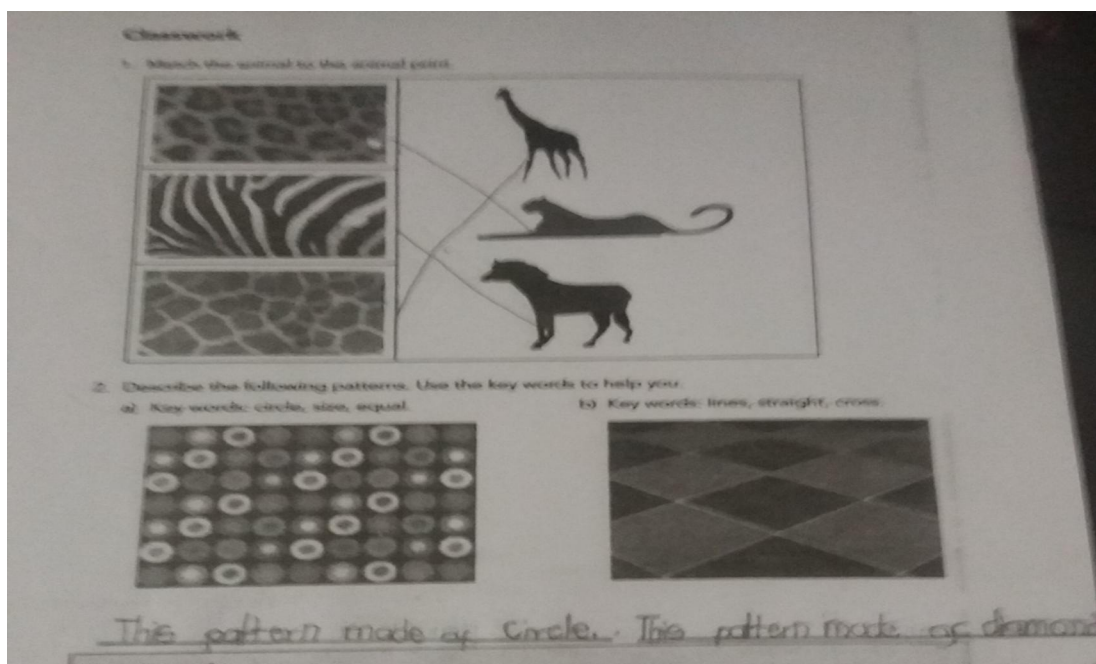


Figure 4.24 Example 2 of the learners' work

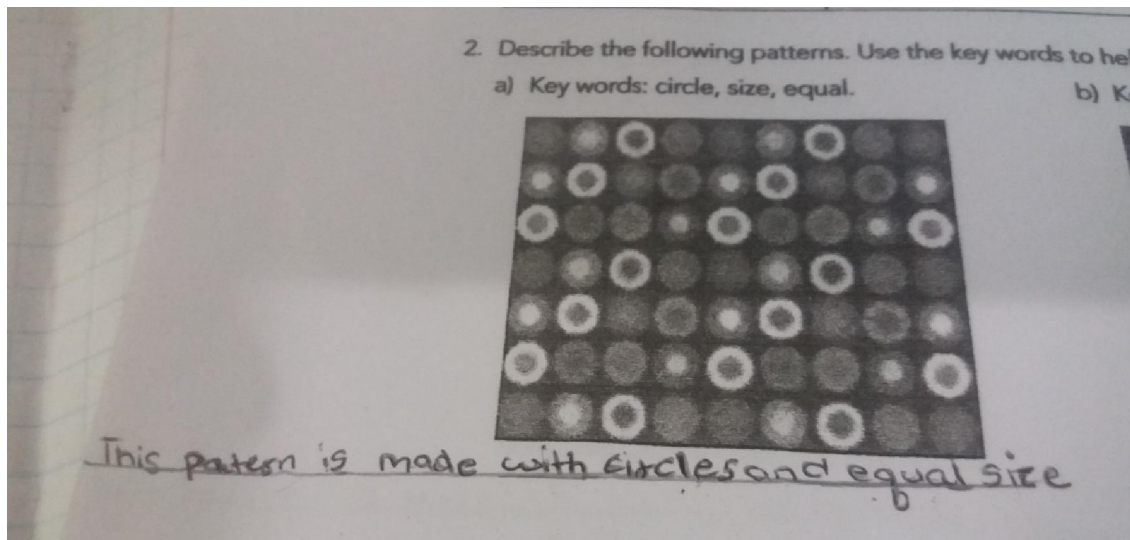


Figure 4.25 Example 3 of learners' work

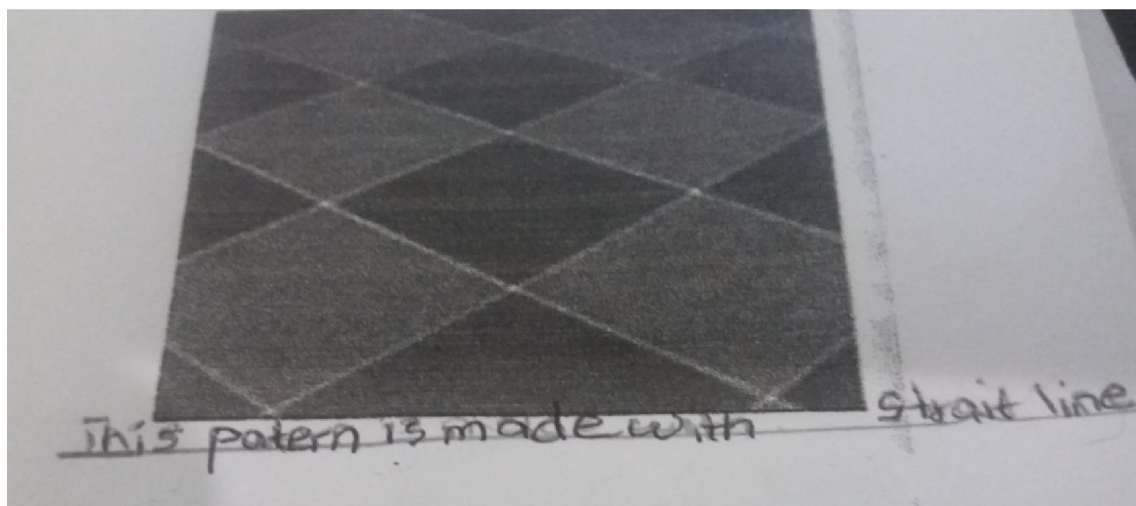


Figure 4.26 Example of learners' work

My observation and learner reflection

Changing my methods from my teacher-centred style of teaching where learners relied solely on my own explanations, to letting learners participate practically and manipulate information, resulted in learners understanding patterns. This strengthened my viewpoint that my new teaching methods improved my teaching of patterns. This became even more explicit when I marked the homework worksheet as it revealed that learners were able to identify, complete, create and describe patterns in different ways. I also observed how excited and stimulated they were when they watched the video and when they created their own collage. Figure 4.26 is an example of a learner's work who used their own words to describe a pattern. This implied that

some learners were applying their knowledge to different situations which resulted in meaningful learning (Wales, 2013).

The aim of the lesson was achieved as learners exhibited their different skills during the lesson not only in mathematics but even skills in reading and writing. They understood patterns in nature because they brought relevant pictures that showed some sort of geometric patterns. Learners were even able to use different attributes to categorise the patterns. I came to the conclusion that if learners are provided with sufficient relevant resources, they will be able to make meaning of their learning. For me, I came to understand that being diligent and thoughtful when choosing resources for my lessons, produced successful learning experiences (Adler et al., 1992).

Conclusion

In this chapter, I focused on responding to my second question: *How can I improve my teaching of patterns*. I drew from my personal history as I planned my lessons. My lessons were an enactment of my four learnings: *creating positive learning environment, employing practical based learning, incorporating games in learners' learning and involving parents in learners' learning*. My aim was to put these learnings into action in my class so that I could improve my practice. My deduction was that my aim of improving my teaching of patterns in mathematics was achieved. I can safely say this because learners worked collaboratively and came up with creative ideas. Meaningful learning took place as they used own words in describing patterns. Learners enjoyed playing an indigenous game that I used to teach patterns and all learners wanted to participate. In all the lessons that I presented, I made sure that I was guided by the CAPS policy document and the activities that learners were engaged in led them to acquire the skills as outlined in the CAPS policy document. Additionally, the learners were able to achieve the designated outcomes as prescribed by the CAPS policy document. This chapter helped me understand that I had been contributing to my learners' inability to understand patterns by not engaging them enough in the lesson. Improving my practice on teaching patterns would also help me when teaching other subjects because I identified that the problem was with my teaching style and pedagogical strategies which I have addressed in the self-study.

In the next chapter, which is the final chapter in this research study, I provide a comprehensive summary of all the chapters in this thesis. I show how my teaching of patterns in mathematics has improved and I also give an account of what I learnt from conducting this study. I bring this self-study journey to an end with a relevant conclusion.

CHAPTER 5

REFLECTING BACK TO CHANGE THE FUTURE

Introduction

The focus of this study was on improving my practice of teaching patterns to grade two learners. The main purpose of this self-study was to explore my present teaching of patterns in mathematics to grade two learners with the ultimate goal of finding new methods of teaching patterns so that I could improve my practice and in so doing, enhance learners' understanding of patterns in mathematics. In the previous chapter, I answered my second question "*How can I improve my teaching of patterns to grade two learners.*" I taught six lessons in this regard but used only three lessons to analyse the data generated. My lessons were based on practical based activities including games. I found that my grade two learners' interest was awakened when I enacted the practical based teaching and incorporated games into my pedagogical activities as part of my new teaching methods because learners were engaging in activities practically. Learners wanted to take part in all the lessons because they wanted to play while they learnt.

Review of dissertation

Chapter One

I commenced chapter one with a description of the focus and purpose of my study. I then provided my personal and professional rationale for embarking on this self-study research project. I then went on to present the two research questions that gave me direction when I generated and analysed data. Furthermore, I delineated social constructivism as the theoretical perspective that framed this study. Having done that, I defined the self-study methodology that I adopted to enact this research study.

Chapter Two

In chapter two, I gave a detailed exposition of the self-study methodology by describing the characteristics of this methodological approach as demarcated by Samaras and Freese (2009) and (Samaras, 2011). I then went on to discuss the context in which the study took place. I described the participants in my study, with me, as the main participant and my learners as being part of my practice. I announce who my critical friend was and I gave a narrative of how

my critical friend supported and encouraged me during my research process while offering constructive criticism and thought-provoking feedback on my research. I also produced a table of my data generation methods and the data sources I was going to use. Then, I showed how I attempted to establish trustworthiness for this study. Finally, I demonstrated how I adhered to the ethical issues pertinent to my study whilst noting the challenges I encountered during the research process and how I overcame them.

Chapter Three

In chapter three, I tackled my first research question: “*What can I learn from my personal history about learning and teaching of patterns?*” I presented a collage which acted as a visual depiction of my learning of patterns in mathematics commencing with my informal learning of patterns in childhood through to my schooling and tertiary education. I spoke about how I learnt about patterns at home even before I went to school although I was not actually explicitly aware of this. I also shed light on how patterns were part of my daily life as I counted stock, planted crops and played indigenous games. I was reminded of the people who played a significant role in my education such as my father and those I hold bad memories of for example my standard three (grade five) teacher. I used artefacts and drawings to illustrate the story of my personal history and to make my memories come alive. I also used a metaphor to delve into and expose certain experiences such as my grade ten mathematics teacher who taught through collaboration. Metaphors helped me to recollect and re-envision my lived experience because metaphors have the potential to reveal submerged emotions and distasteful encounters when words fail you. I was equipped then, to extract my learning from my lived experiences and I identified the following four themes: *creating a positive learning environment for learners, employing practical based learning, incorporating games into learning and understanding parental involvement in learners’ learning.*

Chapter Four

In chapter four, I responded to the second question: “*How can I improve the teaching of patterns in grade two learners?*” I capitalised on my learning from my lived experiences that were revealed in chapter three as the framework within which I enacted my improved teaching strategies. I planned lessons that were more learner-centred, allowing learners to fully participate in their learning. For example, when teaching learners to describe patterns, I used to begin sentences for them to complete but after learning about learner-centeredness from the theory of social constructivism, I gave my learners the leeway to describe patterns by

themselves and thereby develop their own understandings while facilitating the learning process (du Plessis, 2018). In this way, I able to shift my mind-set of being the expert and the only knowledge provider in the classroom. I was able to relinquish control and give my learners the freedom to become co-creators of knowledge as espoused by the social constructivist theory.

This change in mind-set acted as an impetus for broadening my thinking and giving me the courage to incorporate games into my pedagogical activities. This was the key to capturing and sustaining my learners' interest in learning patterns in mathematics. They even set the rules for the game and watched if fellow learners were abiding by the rules of the game. So liberated did my grade two learners become that they created their own resources for the teaching and learning such as shape cards and collage to assist them identify, create and describe a pattern as detailed in the CAPS document (DoE, 2011). I learned that the key to teaching patterns successfully was to make learners aware that patterns formed part of their daily lives as well as their natural surroundings and the environment.

Chapter Five

This chapter is a concluding chapter where I reflect back on my journey. I begin by reviewing each chapter. Using collage, I reveal and analyse my learnings from the study. My learnings stem mostly from what I observed and did when I generated data in chapter four. I also present my learning from the self-study methodology that was adopted in this study. Moreover, this chapter is about highlighting the extent to which I was able to respond to my second research question that I dealt with in chapter four. Going forward, I elaborate on the idea of new teaching methods that I could use to keep improving my teaching of patterns and other concepts in mathematics.

Reflecting back on the study

Constructing a collage to analyse my learning experiences from this study

To reflect back on my study, I again constructed a collage to act as a tool to analyse my learnings during the study. As mentioned in chapter two, collage still emerged as an interesting intervention which gives more understanding of the discourse to both the writer and the reader (Tidwell & Jónsdóttir, 2020). Although I had already chosen to use a collage to analyse my learnings in chapter three, the difference is that the collage in chapter three is more about identifying the learnings from my personal history. This collage differs in the sense that it

reflects how I applied the learnings from my personal history during data generation (see chapter four) and it includes learning from all chapters of this dissertation. Pinnegar and Hamilton (2009) also concur that a collage can be used as an analytic tool. This collage articulates how my learnings assisted me to become a better teacher of patterns and mathematics as a subject. Figure 5.1 is the collage portraying my overall learnings from doing this study.



Figure 5.1 Collage portraying my overall learnings from doing this study

I begin by presenting the whole collage, followed by the zoomed parts of the collage that are used to represent each topic. The collage displays four of the most remarkable learnings from this study. The learnings include: *what did I learn from creating a positive climate in the classroom*, *what did I learn from using collaboration in teaching and learning*, *what did I learn by realising that mathematics is a practical subject*, and *what did I learn from including games in mathematics lessons?*

What did I learn from creating a positive climate in the classroom?

This learning is a continuation of the first learning I identified in chapter three: *creating a positive learning environment for learners*. Even though it may look like this learning is not based directly on teaching patterns, I strongly believe that the attitude of the teacher not only towards mathematics, but also in general and the subsequent atmosphere that is created in the class has a great deal of impact on learners' learning. As I asserted in chapter three, changing my attitude as well as the classroom climate was a position I needed to acquire for the future. I needed to change from spending too much time disciplining my learners, as they seemed unhappy and scared, to planning lessons where they would make educational noise. Clapper (2010) states "passive methods where the learner is a spectator rather than a participant become a norm. This entire process also affects how learning occurs in the brain" (p. 4). Figure 5.2 represents the positive attitude and climate in the mathematics classroom and is extracted from the main collage in Figure 5.1.

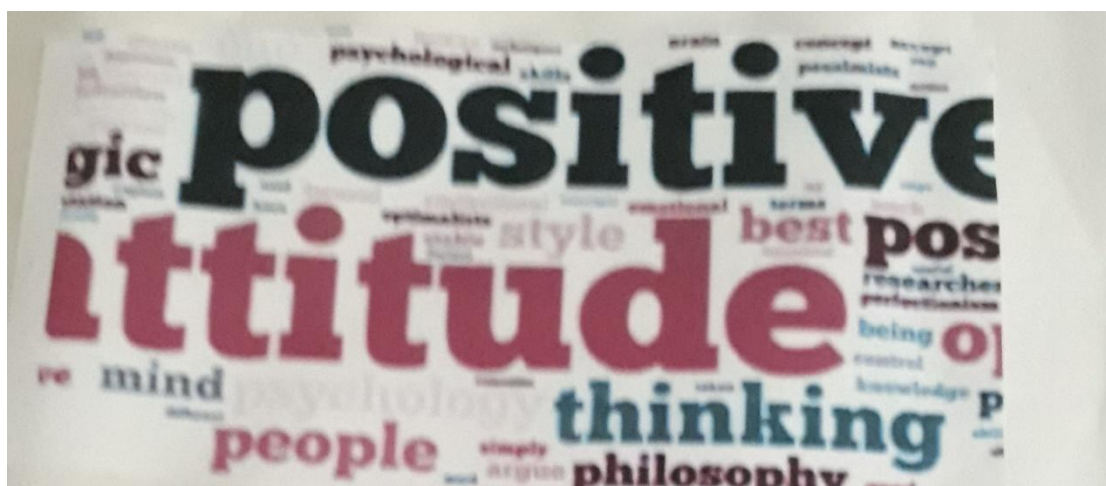


Figure 5.2 Image of words that represent the positive attitude and climate in the mathematics classroom

This metaphoric picture below (Figure 5.3) shows a woman caring for the flowers and the words 'love' and 'care' are written next to the picture. In order for flowers to stay healthy and beautiful, they need to be loved and cared for. Every flower must be nurtured and given individual attention, if they are to flourish and grow in abundance. The flowers represent my learners especially at my learners' tender age. Children also need love, care and attention (Dlamini, 2013). Figure 5.3 is of a woman showing love and care towards the flower representing the teacher showing love and care towards learners.



Figure 5.3 Picture of a woman showing love and care towards the flower representing the teacher showing love and care towards learners.

When I showed my learners that I care by being friendly, they started to trust me and to love me more. They began to shower me with presents (Figure 5.4)



Figure 5.4 Pictures of a magazine, a hand-made card and roses I received from my learners as presents.

Learners also wrote letters to me expressing their love for me as their teacher. This was something that had never happened to me before and it melted my heart especially when I saw that learners were very creative and drew pretty patterns on the letters. They did not realise it

but they were actually drawing patterns in the pictures and I was excited that learners actually learned what I was trying to teach them about patterns. I also learned that some learners did not even have parents so they saw me as a mother figure. They even told me their deepest secrets because I then acted *in loco parentis* (acting in a place of a parent) to them. Figure 5.4 is an example of the letters learners wrote to me.



Figure 5.5 The examples of the letters from my learners to me as their teacher

Batthey et al (2018) emphasize the importance of creating a caring environment in a mathematics classroom. Most literature highlights that mathematics is a practical subject, so if learners do not feel safe and free, they do not contribute in a practical lesson even if the teacher ask them to (DBE, 2011). Clapper (2010) concurs by exclaiming that “fear could also inhibit communication between learners and teachers, which might lead to lack of support that learners need from the teacher” (p. 93). After engaging in this study, I decided not to be harsh and to listen to them more instead of them always listening to me during the lesson. The lessons on patterns I did with them after that were more engaging for them and they looked excited because of the way I interacted with them.

When I introduced games, puzzles, board games, singing, dancing and real objects in the classroom for teaching and learning of patterns, my learners began to love mathematics. The walls of our classroom changed from being full of charts made by me to have a multitude of charts done by learners collaboratively. They enjoyed looking at the charts and talking about them whenever they got time. In chapter one, I spoke about the belief/myth that mathematics is a very difficult subject and that is why most learners fail. My learners were now surprising me more than ever and arriving punctually to the mathematics lesson which is the first lesson

of the day Even the absenteeism rate dropped drastically which proved that their learning context became appealing enough to them to want to come to school.

Learning from using collaboration as a teaching and learning tool

In chapter three, I wanted to include the drawing of a metaphor for collaboration which emerged from the memory of my grade ten teacher, who introduced me to group work as a learning tool. The metaphor I drew was of two light bulbs put together and when switched on, gives off more light than a single bulb. This metaphor symbolises that when a group of people work together to solve any given problem be it mathematical or not, they are in a better position to come up with great solutions. The metaphor became part of the work I had to cut because of the length of chapter three. I illustrate this point of collaboration in Figure 5.6 of an image of me working collaboratively with my critical friend.



Figure 5.6 Image representing me working collaboratively with my critical friend

I came to the realisation that collaboration and interaction between my critical friend and I was an absolute must for my self-study research. By the same token, Dhlula-Moruri et al. (2017)

advocated that self-study depends solely on collaboration and interaction between a group of teachers/ students or between a student and a critical friend. My critical friend assisted me with information, suggested resources for patterns, and even argued with me that led to valuable debates which forced me to dig deeper and find new knowledge about methods of teaching patterns. Figure 5.7 is an image that further accentuates collaboration.



Figure 5.7 Image accentuating collaboration taken from Rainbow workbooks, mathematics grade 2 (DBE, 2017, p. 18)

In figure 5.7, it shows learners possibly discussing the position of a ball against the box or deciding which object can roll and which one can slide. The main idea behind the picture is that learners are sharing thoughts in a collaborative manner. My theory of social constructivism has taught me that “learning is a social and collaborative activity where people create meaning through their interactions with one another” (Vale, 2013, p. 396). Regarding most of the lessons I planned for this study, I created a platform where individual learners could share thoughts in a small group and in turn, the individual learner develops their own understanding and gains much confidence. Figure 5.8 is a picture portraying the moment of understanding after engaging in collaboration.



Figure 5.8 Picture portraying the moment of understanding after engaging in collaboration

This metaphoric image represents the feeling of having a moment of realisation about a problem being resolved or arriving at a solution to a difficult situation after being involved in collaborative learning. I observed my learners when they wanted to complete patterns using terms in chapter four. (Terms refers to each number in a sequence, for example: 3, 6, 9, 12... term 1=3, term 2=6). When I walked around to the different groups, I found that some learners confused a term with a sequence. In the example above, they would say 15 is the next term instead of 5 but after I asked them questions which led them to the correct answer they said “Oh sengyabona manje” meaning “now I can see”. That was the “Aha” moment after working collaboratively. Collaboration empowered learners with creative thinking skills because when they discussed in their small groups they solved higher order problems as they brainstormed different ways of solving a problem.

Realising that mathematics is a practical subject

This learning became apparent because most literature on patterns and mathematics places emphasis on engaging learners in practical tasks for effective teaching. As mentioned in chapter two, the teaching method I relied on before doing this study, was the demonstration method or show and tell method, where I demonstrated how to do the first sum and that was followed by learners emulating me in completing the other examples. This was exactly what my mathematics teacher in standard 9 (grade eleven) did as mentioned in chapter three. I was

unconsciously doing the same. Wright (2017) reinforces this viewpoint by arguing that “mathematics teachers show a tendency to adopt the same pedagogies they themselves experienced as learners (p. 3). After involving myself in this study, my lesson planning changed from focusing on what I would do in class to what learners would do while learning. I learned that social constructivists advocate for learners to construct knowledge by themselves and for the teacher to facilitate the process (Armstrong, 2019). Figure 5.9 is a picture of learners manipulating objects to construct knowledge in a practical learning.



Figure 5.9 Learners manipulating objects to construct knowledge in a practical learning

The above picture depicts learners working with resources to solve mathematics problems. When I needed to teach geometrical patterns in one of the lessons (chapter four), I involved learners in making the shape cards which they later used to create and describe increasing patterns (both in size and in quantity). While making shape cards, learners corrected one another as some created for instance rectangles instead of squares. I noticed that those who were not sure or had forgotten shapes, learned them well that day because they were practically making them. Attard (2017) highlights the significance of designing lessons that relate to learners. In this regard, I made sure that the resources and objects that learners used for learning patterns were familiar to them.

Furthermore, reading about the teaching of patterns has taught me that young learners are very active and they use the energy that they have in one way or another (Beswick & Goos, 2018) .

In chapter one, in my personal rationale of doing this study, I mentioned that I had a difficult time disciplining young learners. After engaging in this study, I realised that I was mistaken when I expected learners to be passive and absorb information from me while I was taking away their chance of critical thinking. Similarly, Makonye (2019) concurs that “critical thinking may be referred to as an active way of thinking in which young learners effectively utilise the acquired knowledge in practical experiences” (p. 13). When I engaged learners more intensively, I experienced what Madide (2018) meant when he asserted that learners in a mathematics class become happy when they are engaged in practical learning because my learners looked happy and eager to learn since my methods changed.

Learning from including games in mathematics lessons

Learners at all ages love to play. Indigenous games taught me to count even before I got to school (see chapter three), so this study made me aware that learners could learn more if they play. Figure 5.10 is a picture of children playing an indigenous game where they create a rhyming pattern by clapping and dancing.



Figure 5.10 Picture of learners playing an indigenous game where they create a rhyming pattern by clapping and dancing

The picture shown above showcases the pattern created by the rhyme when children clapped hands and danced. Evidently, as shown in the picture, children learn patterns and mathematics even before they get to school. Vygotsky (1978); Vygotsky and Cole (2018) and Armstrong (2019) all accord that learners come to the learning environment with some knowledge and my

job as a teacher is to furnish them with a social settings where they can construct new knowledge or develop the knowledge they already have. Using games in my lessons was also informed by the theory of constructivism because when I engaged my learners in playing hopscotch, they brought with them the knowledge of playing the game and the new knowledge of number sequencing (counting in 3's and 5's) while playing the same game. The picture below illuminates this point most eloquently. Figure 5.11 shows that a well-planned game should serve a learning purpose while learners are having fun.

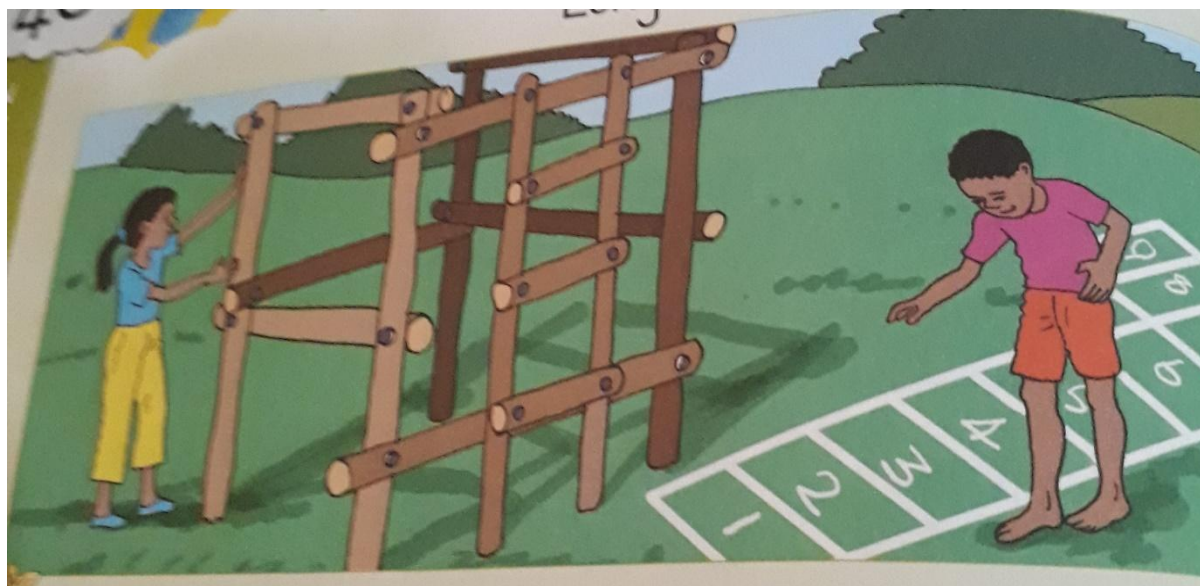


Figure 5.11 Image of a well-planned game which serves a learning purpose while learners are having fun. Taken from Rainbow workbooks, mathematics grade 2 (DBE, 2017, p. 84)

In the picture above, it seems that learners were learning about measuring length. The boy uses his feet and the girl might be using a ruler to measure their objects. Probably they played the game first. My aim of including this game is to highlight what this study has taught me about choosing games that are educational and relevant. Akcaoglu (2014) cautioned that when planning to use games, a teacher should have a clear objective in mind for learners to achieve. I also had to dismiss some games because they failed to serve an objective of the lesson.

Incorporating games in my teaching of patterns taught me that what learners learn through playing games, the lesson has more meaning for them, as they all love to participate in the games. Games enhanced both collaborative and practical learning because it promoted interaction and problem solving skills. O'Donnell (2019) advocates that “games provide a constructivist classroom environment where students and what they learn are central” (p. 11).

My Personal- Professional Learning

This study has taught me a lot concerning my teaching of patterns and mathematics as a subject in the primary school. I learnt that young learners have a lot of energy so they can do anything to use their energy including making noise and being restless in class (Beswick & Goos, 2018; Makonye, 2019) In chapter one I mentioned that I was failing to discipline foundation phase learners but after learning the new methods of teaching patterns and mathematics, this problem was solved since my new teaching methods afforded my learners the opportunity of engaging in activities where they could be active

The DBE entrusted me to use my pedagogical practices to assist learners to acquire competencies and objectives for learning patterns such as identifying, extending, describing and creating their own patterns (DBE, 2011). Working with my critical friend in unpacking these outcomes, taught me that collaborative planning is indispensable to schools because we both (my critical friend and I) agreed that we should not restrict ourselves only to what the policy wanted but also to consult other sources such as books. Also, readings about patterns emphasise that patterns are a gateway to algebra, which is known to be a difficult section in mathematics at high schools. Beswick and Goos (2018); du Plessis (2018) both agree that algebra needs learners to think critically and solve mathematical problems. So, when my critical friend and I looked closely at these objectives, we were reminded of Bloom's taxonomy back in the college years where we needed to check assessments to ensure there was progression from lower order questions to higher order questions.

The words identify, extend, describe and create had new meaning for me. I realised they needed learners to apply, analyse and create which are part of high order thinking skills in keeping with Bloom's taxonomy (Armstrong, 2016). The theory of social constructivism that I adopted as a lens through which to view my research study, assisted me in realising that the way I was enacting the curriculum on patterns was not helping the learners because I did not use the correct methods to enable learners to achieve the desired outcomes. When I moved from being the centre of learning and allowed learners to be active as suggested by social constructivists, I observed the change in learners' faces, actions as well as their attitude toward mathematics (Draper, 2013).

In addition, I learned that patterns do not only connect with other concepts in mathematics but they also feature in other subjects such as arts and culture. In one of the three lessons, which I decided not to use as part of generated data in this study (see chapter four), I used music to

teach learners to identify patterns made by the rhyme in the song. The rhythmic sound of tapping, clapping and jumping learners, could be related to performance arts. Visual arts was highlighted when learners had to draw their hopscotch grid, make their shape cards and when they created their collage. Language was part of patterns because learners had to express themselves in a foreign language to describe patterns. I learnt that integration across learning areas is vital so that learners can see that learning does not take place in the lesson of a particular subject. Rather learning occurs in a holistic fashion.

Methodological learning

Self-study taught me about introspection. When I first read about introspection in self-study research, I thought it was impossible because I believed I was right and the problem was with learners, not with me. Besides, it was not so easy for me as a teacher to put myself in a vulnerable position of taking the blame after I had taught for so many years. When I researched my past through personal history, I found myself in my learners' shoes and realisation dawned on me and I empathised with learners and understood how they were feeling (see chapter three). Pinnegar and Hamilton (2009); Mitchell, O'Reilly-Scanlon and Weber (2013); (LaBoskey, 2004) together recommend that a teacher is expected to do introspection to see whether their teaching is good or not, so that they can improve and hence improve learners' understanding.

Self-study has taught me about the importance of reflection. I concur with Attard (2013) when he declares that reflection should be taken as a central part of teaching. I have heard of reflection with the introduction of the CAPS policy document, but I did not take it into account when drawing up weekly lesson plans as expected at school. I continued to teach as I planned until the end of the week. After engaging in this self-study, my lesson plans are done on a daily basis so that I can reflect on my previous lesson, make adjustments to my teaching plan before I plan the next lesson.

Moreover, self-study has up-skilled me with situating myself in the research since I had to look back and write about my personal history and research on my teaching practice (LaBoskey, 2004). Traversing through my personal memories, I found that the way I grew up and how I was taught, impacted on the way I have been teaching. Engaging in writing my personal history, equipped me with the knowledge about the informal way of learning mathematics, which took place while doing household chores and playing indigenous games, were a cue to how learners should learn mathematics at school. This taught me that learners learn well if they are active so I included practical based learning as I generated data and it was most effective.

When I wrote about my personal history, I just got carried away and forgot to adhere to my topic. When I was still a primary school learner, I did not learn about patterns so I had to look deeper into patterns to see that number sequencing, number value, counting backward and forward are part of patterns. I had a hard time confining my story to the topic. I also wish I had known this when writing my chapter three, that I was going to select only some of the learnings when generating data in chapter 4. This is a valuable lesson to be learned here.

Moving forward

Going forward, when teaching patterns, I will continue to plan activities that are learner-based because I have seen that learners are always eager to actively do something rather than listening to me explaining what they should do. The learner-centred approach ensures that learners take responsibility for their own learning and discover knowledge for themselves. I will also continue to plan indigenous games such as umagenda (stone-throwing game and counting), hopscotch and other games such as puzzles when teaching patterns that will help them recognise the sequence of some numbers. When they learnt through play and games, they were able to describe patterns. Games kept them enraptured in the lesson and I could see that they enjoy the lessons because all children love playing.

The next time I teach patterns, I will arrange a few laptops with the principal and let learners play pattern computer games that I will download, which are relevant to their age and grade even if it means one group a day. I now know that this will make an extraordinary impact in helping learners understand patterns better and faster while they enjoy playing with computers. This may improve their algebraic thinking. Correspondingly, in the revised Annual Performance Plan report, the department of education mentions that about two-thirds of teachers in the system received the Initial Teacher Education (ITE), which was obtained before 2000, and they have introduced some reforms and improvements which should be finished by 2038 (DBE, 2020). One of the improvements is “...to offer Continuous Professional Teacher Development (CPTD) to enable teachers to update their skills because teaching methods evolve as new technologies emerge” (DBE, 2020, p. 24).

Conclusion

Through self-study research, I examined my personal history in relation to learning of mathematics, particularly patterns. As part of my first research question, I retrieved memories

that negatively and positively influenced my practice. The learnings I acquired from my past lived experiences assisted me to respond to my second research question “*How can I improve my teaching of patterns to grade two learners?*” as revealed in chapter four. The learnings helped me channel my methods of teaching patterns that was supported by the theory of social constructivism that I adopted to frame this study. Teaching through collaboration, practical engagement and games became my most profound learnings that brought improvement in my teaching of patterns. Adopting a friendly approachable and caring disposition in the classroom such as praising a child for his/her efforts, transformed learners’ attitudes towards mathematics for the better.

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APPENDICES

APPENDIX A: CLEARANCE LETTER FROM UKZN



12 February 2018

Mrs Bettah Ntombizethu Mthembu 200402052
School of Education
Edgewood Campus

Dear Mrs Mthembu

Protocol reference number: HSS/0034/018M
Project title: Teaching patterns to Grade Two learners: A teacher's self-study research

Full Approval – Expedited Application

In response to your application received 15 January 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

Professor Shenuka Singh (Chair)
Humanities & Social Sciences Research Ethics Committee

cc. Academic Leader: Research: Dr SB Khoza
cc. School Administrator: Ms Tyzer Khumalo

Humanities & Social Sciences Research Ethics Committee

Professor Shenuka Singh (Chair)

Westville Campus, Govan Mbeki Building

Postal Address: Private Bag X54001, Durban 4000

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Website: www.ukzn.ac.za



Four main Campuses: Edgewood Howard College Medical School Pietermaritzburg Westville

APPENDIX B: PERMISSION LETTER FROM THE DEPARTMENT



education

Department:
Education
PROVINCE OF KWAZULU-NATAL

Enquiries: Phindile Duma

Tel: 033 392 1041

Ref.:2/4/8/1313

Mrs BN Mthembu
50 Campbell Road
New Germany
3610

Dear Mrs Mthembu

PERMISSION TO CONDUCT RESEARCH IN THE KZN DoE INSTITUTIONS

Your application to conduct research entitled: **"TEACHING PATTERNS TO GRADE TWO LEARNERS: A TEACHER'S SELF-STUDY RESEARCH"**, 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 04 August 2017 to 09 July 2020.
7. Your research and interviews will be limited to the schools you have proposed and approved by the Head of Department. Please note that Principals, Educators, Departmental Officials and Learners are under no obligation to participate or assist you in your investigation.
8. Should you wish to extend the period of your survey at the school(s), please contact Miss Connie Kehologile at the contact numbers below
9. Upon completion of the research, a brief summary of the findings, recommendations or a full report/dissertation/thesis must be submitted to the research office of the Department. Please address it to The Office of the HOD, Private Bag X9137, Pietermaritzburg, 3200.
10. Please note that your research and interviews will be limited to schools and institutions in KwaZulu-Natal Department of

Siyanaluyisa Gijimay Gijimol


Dr. EV Nizama
Head of Department: Education
Date: 04 September 2017

KWAZULU-NATAL DEPARTMENT OF EDUCATION

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APPENDIX C: CONSENT LETTER TO CRITICAL FRIENDS

53 The Campbells
50 Campbell Road
New Germany
3610

Dear Critical friend

CONSENT LETTER TO CRITICAL FRIENDS

Title: The teaching of patterns to Grade 2 learners.

The purpose of conducting this study is to explore what I can learn from my personal history about teaching of patterns and how can I improve my teaching of patterns.

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.

In this study it will be useful to record our group class discussions as a method for data collection. I will request your additional time for us to meet to discuss our collage development memories. Other contributions will be from our meetings during our group supervision meetings. I hereby request your permission to use your valuable contributions during our critical friends meetings and to avail yourself for further meeting discussions. You will be notified in advance with the date and time for our meetings.

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 are 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
B N Mthembu

INFORMED CONSENT DOCUMENT FOR PARTICIPANTS

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

APPENDIX D: CONSENT LETTER TO PARENTS

Siyakhanyisa Primary School
P.O. Box 1706
Empangeni
3880
22 March 2017

Dear Parent/Guardian

CONSENT LETTER TO PARENTS

Title of study: Teaching of Patterns in Mathematics

The purpose of conducting this research is to improve my teaching of patterns in such a way that all learners understand and enjoy them.

My aim is to find out from learners which approach and methods I use that make them understand the patterns.

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 learner journal and learners' written work. 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 contribution when I generate data for this research.

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 learners work will be safely stored and discarded if no longer required for research purposes. Your 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 patterns in Mathematics. I also wish to inform you that you do not have a legal obligation to 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.

Thank you.

Yours truly,
B.N. Mthembu

INFORMED CONSENT DOCUMENT TO USE CHILD CONTRIBUTION TO RESEARCH

TITLE OF THE STUDY: THE TEACHING OF PATTERNS: A TEACHER'S SELF 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 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 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

