



**TEACHERS' EXPERIENCES OF TEACHING NUMBER PATTERNS TO GRADE 7
LEARNERS IN KWAZULU-NATAL**

by

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DECLARATION

I, Emmanuel Bentum Djan, hereby declare that the work on “Teachers’ experiences of teaching Number Patterns to grade 7 learners in KwaZulu-Natal” is my own work and has not been submitted for any degree or examination in any University, and that all the sources I have used or quoted have been adequately indicated and acknowledged by means of complete references.

Researcher:



Date: 2 December 2025

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Date:

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DEDICATION

This dissertation is dedicated to my wife, Mrs. Djan Bridgette Sthandiwe Mngwengwe and my children, who supported me both emotionally and spiritually with their prayers and jokes to make me feel better throughout my study. This dissertation is also dedicated to my mother, Boafo Mary Adutwumwaa (AKA BAAKO), whose prayer is always with me, and to my late pastor T. A. Khanyile, for her mentorship.

ABSTRACT

This research explores the experiences of teachers in teaching Grade 7 learners on Number Patterns in KwaZulu-Natal. A review of scholarly literature, both local and international, reveals various strategies employed by seasoned mathematics teachers when teaching the concept of Number Patterns in their classrooms. The study was guided by two research questions: What are the teachers' experiences in teaching Number Patterns to grade 7 learners in KwaZulu-Natal? In what ways do teachers' experiences influence their approaches to teaching Number Patterns in Grade 7? Teacher participants were purposively selected based on their experience teaching Number Patterns in Grade 7. The data generation was done through a one-on-one semi-structured interview and a classroom lesson observation that was analysed thematically. Themes and sub-themes were derived from the feedback provided by the teacher participants, which informed the study's findings. As a qualitative research endeavor, the study was grounded in an interpretive paradigm, utilising social constructivist theory as its foundational framework. The findings indicated that teachers used various approaches to help develop knowledge and understanding in the learning of Number Patterns. Teachers assisted learners to develop critical observation skills which helped learners to determine a trend within any given numerical and geometric patterns. The promotion of social learning through interactive activities within the classroom suggests in-depth knowledge of content and methods that teachers have gained over years of practice that impact on the learners' understanding. The use of concrete objects, manipulatives, and digital learning tools in teaching the concept of Number Patterns in Grade 7 shows the level of curriculum differentiation implemented by teachers during their classroom practices.

Keywords: Teachers' experiences, Number Patterns, Teaching, teaching approaches, Mathematics

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ACRONYMS USED IN THE DISSERTATION

ACRONYMS	DEFINITION
ATP	Annual Teaching Plan
DAT	Digital Annotation Tools
DBE	Department of Basic Education
FET	Further Education and Training
KZNDoe	KwaZulu-Natal Department of Education
LMS	Learning Management System
MM	Mathematical Modelling
NSCE	National Senior Certificate Examination
NCS	National Curriculum Statement
OBE	Outcome-Based Education
PCK	Pedagogical Content Knowledge
PD	Professional Development
RME	Realistic Mathematics Education
STEM	Science, Technology, Engineering and Mathematics
CAPS	Curriculum and Assessment Policy Statement
UWC	University of Western Cape

UKZN	University of KwaZulu-Natal
ZPD	Zone of Proximal Development

CHAPTER ONE

OUTLINE OF THE STUDY

1.1 INTRODUCTION

This study focused on teachers' experiences of teaching Number Patterns to Grade 7 learners in KwaZulu-Natal. In South Africa, teachers have a challenge of teaching mathematics to learners with a poor mathematical background (Askew, 2013). Teaching the concept of algebra and Number Patterns has become one of the challenges teachers face in the mathematics classroom (Depaepe, De Corte, & Verschaffel, 2017). Mathematics is given attention in the curriculum in South Africa and in the media whenever the National Senior Certificate results are released, due to the importance of mathematics in later stages of learning and life. In terms of mathematics teaching, the changes in teaching approaches, from transmission of knowledge and procedures to building understanding and meaning, are linked to the work of Piaget and Vygotsky (McDevitt & Omrod, 2007).

Mathematics teachers are required to develop specific content knowledge and methodology to teach learners through their experiences. In Australia, mathematics teachers are often engaged in short-term professional learning programmes or research (Lerman, 2013), and the professional learning and discussions that take place are divorced from any shared experiences of teachers in the classroom (Grigg & Lewis, 2016). The topic 'Number patterns' as part of algebra has been one of the challenging concepts that learners face when they move from primary school to high school. As a Mathematics teacher who taught in high school for many years, I experienced challenges with learners at the Grade 8 level, which persisted to the Grade 12 level. At present, I serve as a mathematics teacher for the senior phase (grade 7) and have encountered the difficulties that high school mathematics teachers face. Therefore, the research on Teachers' Experiences in teaching Number Patterns to Grade 7 learners is significant, as it impacts learners' understanding of algebra. This study on teachers' experiences in teaching Number Patterns to Grade 7 learners will provide valuable insights for mathematics teachers in the senior phase.

The challenges and obstacles encountered by teachers in teaching Number Patterns are associated with helping learners comprehend the problem, identifying patterns, and formulating generalisations. These processes are essential components of algebraic understanding in mathematics (Alajmi, 2017; Kieran, 2004). Teaching Number Patterns can assist learners in

enhancing their inductive reasoning, resolving mathematical issues, and deriving generalisations in mathematics (Mulligan & Mitchelmore, 2009). The topic Number Patterns has become an integral part of the mathematics curriculum in South Africa and many parts of the globe, but results from research (Lannin, 2005; Rivera, 2013; Warren, 2005; Radford, 2010; Kieran, 2004) show that most learners find it difficult to understand Number Patterns.

The challenge of teaching Number Patterns in Grade 7 is how teachers link the concept of Number Patterns to make generalisations through the identification of inductive reasoning and identifying the learning obstacles in generalising Number Patterns (Maula et al., 2024). The classification of different forms of patterns, which are integrated into the mathematics curriculum, also poses a challenge to teachers as they strive to ensure learners develop a concrete understanding of Number Patterns. The use of concrete (visual) and abstract objects in teaching Number Patterns is problematic for teachers when trying to make learners link ideas in making generalisations (Gripton, 2022).

The present chapter addresses the following topics: the study's location, its background, the rationale behind the study, its significance, critical research questions, the study's focus, methodology, definitions of the key terms, an outline of the chapter, and the conclusion. The study comprises six chapters.

1.2 LOCATION OF THE STUDY

The study was conducted in four main educational institutions. These institutions are located within the Ubuhlebezwe Local Municipality area in the Harry Gwala District of KwaZulu-Natal. It is a rural district, and most schools are situated on the rural farms of the district. The socio-economic status of the people ranges from middle-income earners to low-income earners, and most learners are supported by social grants. Some of these schools have mathematics teachers who did not specialise in mathematics. The district shares the border with the Eastern Cape provinces. The geographical location of the area influences the multilingual nature of the people in the area. Most schools in the district are “section 21” schools. These are schools characterised by their ability to manage their finances, staff, and curriculum (Fataar, 2017). Section 21 schools have more freedom to innovate and experiment with new teaching methods and programmes (Mestry, 2018). These schools are also required to have a governing body that includes parents, teachers, and community

representatives. The schools offer a model of education which balances autonomy and accountability.



Figure 1.1 Location of the study

Figure 1.1 This image represents the socio-economic background of seventh-grade learners in the Ubuhlebezwe local community, highlighting the living conditions of individuals ranging from low-income to middle-class earners, which play a vital role in teaching and learning within the area. Picture taken from Ixopo Midland KZN (www.midlands-info.co.za)

1.3 BACKGROUND OF THE STUDY

South Africa has various systems of education, which include private and public schooling systems. Some schools are categorised as under-resourced and fully resourced schools (Muyanbi & Ahiaku, 2025). One of the subjects available in educational institutions is mathematics, which continues to face a crisis in pass rates across the nation. Teachers encounter challenges in teaching this subject, particularly for primary school learners. This is supported by Machaba (2013), who

states that the problem of poor mathematics performance and teaching is not only experienced in South Africa but is a universal issue.

Following the democratic elections in South Africa in 1994, the South African education system underwent a shift from a segregated system based on racial discrimination, which created academic and knowledge gaps among learners from different racial backgrounds (Cross, Mungadi, & Rouhani, 2002), to an integrated system. Outcome-Based Education (OBE), adapted in a new curriculum (C2005), aimed to bridge the gap between different racial groups and create a unified educational system within South Africa.

This curriculum provided all learners with access to a unified educational system, regardless of their race. Inasmuch as the OBE was supported by teachers, the teaching of certain mathematics topics to learners, especially in the primary school, was a challenge, and the OBE did not meet the educational needs of South Africa (Botha, 2002). The OBE's outcome-based approach was confusing for teachers, learners, and parents because of a lack of clarity (Chetty, 2001). Teachers did not receive sufficient training to effectively implement Outcome-Based Education (OBE), which led to challenges in both assessment and curriculum development (Mestry, 2004). OBE emphasised critical thinking and problem-solving abilities, often at the cost of fundamental subject knowledge (Taylor, 2003).

The National Curriculum Statement (NCS) was adapted and implemented in 2002 to fill in the gaps of C2005 (Spaull, 2016). The mathematics curriculum broadened, making it difficult and challenging for teachers to complete their Annual Teaching Plan (ATP). The integration of topics within mathematics and between mathematics and other learning areas became more complicated for teachers (Ensor, 2017).

In the curriculum of South Africa, mathematics is taught from primary to secondary at the basic education level. It is one of the major learning areas that determines the progress of a learner from one grade to another. As a prerequisite for the progress of learners, the experiences of teachers in teaching mathematics in Grade 7 are critical. Mathematics teachers at the primary school are required to assist learners in developing all the basic knowledge and skills needed for a better

understanding of mathematical ideas and concepts, and should be able to solve problems through mathematical reasoning and deduction in real-life situations (Ajani & Popoola, 2013).

Mathematics underperformance has become a crisis in the education system in South Africa. Given that the subject has attained the status of being the most essential learning area at both primary and secondary school levels, it has garnered significant attention in the National Senior Certificate Examination (NSCE). The National Curriculum and Assessment Policy Statement (CAPS) for mathematics allows for more integration of mathematical concepts in the teaching of mathematics (Graven, 2014).

The incorporation of Number Patterns and the generalisation of patterns into the Grade 7 mathematics curriculum has emerged as one of the more challenging subjects for teachers to teach in Grade 7. Teachers vary in their experiences of teaching, which plays a vital role in the teaching of mathematics. The experiences of teachers may be positive or negative, but they influence the classroom environment in terms of teaching Number Patterns (Even, 2011). Grade 7 is a critical phase in primary school, and teachers' experiences of teaching in Grade 7 should provide critical knowledge that will assist learners in their future mathematics education at the secondary level. Numerous learners hold the false belief that mathematics is intended solely for exceptionally intelligent individuals with advanced computational abilities (Hill & Ball, 2004). The primary objective of this study is to explore teachers' experiences in teaching Grade 7 learners Number Patterns and to assess how these experiences influence the learning outcomes of learners in the mathematics classroom.

The experiences of teachers, both within and beyond the classroom, have a significant influence on the mathematics classroom (Piyakun & Phusee-orn, 2025). Exploring Grade 7 mathematics teachers' experiences provides insight and understanding into the teaching of mathematics in the classroom. It gives teachers different perspectives on classroom practices in the teaching of mathematics.

1.4 RATIONALE OF THE STUDY

As a mathematics teacher in the senior phase (SP) and Further Education and Training (FET) phase for the past sixteen years. In my experience, learners who progressed from Grade 7 to Grade 8

always experienced difficulties in mathematics academic attainment. They had the challenge of thinking through Number Patterns, a concept that is supposed to have been taught in Grade 7, giving learners the foundation of patterns in mathematics. The concept of Number Patterns is a fundamental one for a child to develop algebraic thinking and reasoning (Gripton, 2022). My experience led me to assume that experience promotes effectiveness in the learning environment. I believe that experience in teaching mathematics helps to create an effective and conducive environment for learning. The teaching of mathematics depends on the content knowledge, pedagogical knowledge, and organisational experience of the teacher within the classroom context. According to Gripton (2022), patterns are fundamental to mathematics learning. Developing the concept of patterns in Grade 7 provides learners with a better chance of linking concepts and identifying relationships within mathematical concepts (Gripton, 2022).

This study is undertaken for both personal and professional reasons. One of my personal reasons is that, when I was growing up, I had the challenge of understanding the number system and identifying different forms of Number Patterns. These challenges and difficulties I faced as a mathematics learner during my primary and junior secondary school levels had a negative impact on my perception of mathematics, which gradually changed during my high school level. These reasons justify the conduct of this study in Grade 7.

The professional reasons were my experiences as a mathematics teacher. I had difficulties in making learners understand the concept of Number Patterns in Grade 7, using the traditional method of rote learning and drilling of learners on the topic. This challenge was also because of the scarcity of resources to teach the topic. Teachers relied on available textbooks at school, which were inadequate to drill learners in day-to-day lessons. My observation from other colleagues is that mathematics teachers use Number Patterns to introduce pre-algebraic activities and measure learners' understanding of basic mathematical concepts. I thought exploring teachers' experiences in teaching Number Patterns in Grade 7 would lay a better foundation for algebraic reasoning through numerical patterns when learners are progressed to Grade 8 and beyond. Currently, as a Grade 7 mathematics teacher, the concept of Number Patterns demands a teacher to be able to make learners understand the various types of patterns and their generalisation. In my classroom, the development of a rule for a particular pattern is still a challenge for my learners.

Number Pattern is the development of a rule or a conjecture that enables learners to predict the numbers within a particular given condition. According to Mulligan and Mitchelmore (2009), the goal of mathematics learning is to identify patterns within a particular concept. Identifying patterns within any mathematical concept aids learners in connecting ideas during their overall mathematics education. As noted by McCrory et al. (2012), referenced by Obara (2019), if elementary school teachers lack the necessary knowledge to assist learners in transitioning from numbers and arithmetic to understanding relationships (patterns), then grasping functions may prove difficult. Several researchers have explored this subject (Jureczko, 2017; Spangenberg & Pithmajor, 2020). Nonetheless, they have not addressed the experiences of teachers teaching Grade 7 learners in Number Patterns.

1.5 SIGNIFICANCE OF THE STUDY

The South African education system aims to develop learners holistically, enabling them to participate in the challenging global economy (Adams, 2017). Mathematical knowledge and understanding are fundamental in both local and international markets. Consequently, a mathematics teacher ought to teach learners in connecting and utilising their classroom experiences of learning mathematics to the practical application of mathematics in their everyday lives (Schoenfeld, 2014).

The teaching of Number Patterns to Grade 7 learners provides an opportunity for learners to cultivate critical thinking abilities, generalisation skills, and the application of mathematics in making important decisions in real-world scenarios. The study aimed to explore the experiences of mathematics teachers in Grade 7, specifically their classroom practices and some of the challenges they face in teaching Number Patterns.

The study addressed some of the professional challenges, such as the methodology used during the lesson, the teaching materials used during the lesson, and how learners are assisted to develop algebraic thinking skills. The study also considered the personal experiences of mathematics teachers against their professional experiences in teaching Number Patterns. The study shed light on the good practices and strengths of mathematics teachers in primary schools. The exploration of teachers' experiences helped deepen their understanding, which helped the teachers to explore other methods in teaching Number Patterns to learners in Grade 7.

The study added to the good practices and experiences of mathematics teachers as they share their experiences with other teachers. The experiences and findings from the study motivated Grade 7 mathematics teachers to reflect on their classroom practices and to re-evaluate their pedagogical knowledge, which brought the dimension of making mathematics (Number Patterns) more alive and practical, not abstract (Brown, 2017). Mathematics teaching, especially in Grade 7, demands an innovative teacher who can make learners develop the skills and a positive attitude towards mathematics learning. There is a chance that this study can assist the Department of Education and all stakeholders in understanding the challenges Grade 7 mathematics teachers face, and enhance teacher training workshops based on the findings.

1.6.1 RESEARCH OBJECTIVES

- To explore teachers' experiences of teaching Number Patterns to Grade 7 learners in KwaZulu-Natal.
- To understand how teachers' experiences influence their approaches to teaching Number Patterns in Grade 7.

1.6.2 CRITICAL RESEARCH QUESTIONS

- What are the teachers' experiences in teaching Number Patterns to Grade 7 learners in KwaZulu-Natal?
- In what ways do teachers' experiences influence their approaches to teaching Number Patterns in Grade 7?

1.7 FOCUS OF THE STUDY

The focus of the study was to explore teachers' experiences of teaching the concept of Number Patterns to Grade 7 learners through their lived experiences in the classroom. Delivering content knowledge to learners for better understanding depends on the experiences of a particular individual teacher in breaking down the concepts into smaller sections (Hmelo-Silver, 2004). Meaningful mathematics teaching is dependent on teachers' experiences and abilities, gathered over the years, to help learners relate to the concepts taught (Mayer, 2004). The selection of the Number Patterns concept for this study is because Number Patterns constitute the foundation of algebra and functions within the mathematics curriculum in South Africa. The concept of Number Patterns is an integral part of the primary school mathematics curriculum, which serves as a basis

for learners to develop the skills of generalisation (Houssart, 2000; McGarvey, 2012; Gripton, 2022).

The primary objective of this research was to gain insight into the specific experiences of teachers while conducting classroom activities and providing interventions to learners during mathematics teaching. Additionally, the study aimed to motivate Grade 7 mathematics teachers to adopt strategies that would enhance learners' comprehension of mathematical concepts. The research explores the various techniques and approaches used by mathematics teachers in teaching the Grade 7 mathematics curriculum.

1.8 METHODOLOGY

The present study generated data from four Grade 7 mathematics teachers across four distinct schools. The participants were selected through purposive sampling, ensuring representation from both genders. Each participant had over five years of experience teaching mathematics at the Grade 7 level and expressed a willingness to take part in the study. Data generation methods included classroom observations and face-to-face semi-structured interviews.

This research was qualitative in nature, as the researcher engaged with teachers in their respective schools where they served as full-time mathematics teachers (Ndoziya, 2014). The interpretive paradigm was utilised in this study, focusing on the exploration of teachers' experiences, which encompassed their beliefs, attitudes, and values regarding the teaching of mathematics (specifically Number Patterns) to Grade 7 learners (Patton, 2015). The purpose of this paradigm was to elicit content and data from the participants concerning their experiences, which contributed to a multitude of realities surrounding the teaching of Number Patterns to Grade 7 learners. This approach enabled the researcher to observe the non-verbal behaviour of the participants during the interviews, thereby enhancing the comprehension of the data generated (Creswell & Creswell, 2017).

1.9 DEFINITIONS OF TERMS

1.9.1 Mathematics

Mathematics is the discipline that explores quality, structure, space, and change. Mathematicians identify patterns, develop new conjectures, and ascertain truths through rigorous deductions based on carefully selected axioms and definitions (Khait, 2005). Mathematics can be viewed as a

collection and examination of assumptions, beginning with axioms and culminating. It has been acknowledged as the foundation of all fields that primarily focus on creativity, problem-solving, and logical reasoning (Khait, 2005). Mathematics is one of the most powerful and adaptable mental tools that the intelligence of man has made for his own use over the years (Yadav, 2017).

1.9.2 Number pattern

The strength of mathematics is found in its relations and transformations, which lead to the emergence of patterns and generalisations. The abstraction of patterns forms the foundation of structural knowledge, which is the objective of learning mathematics (Warren, 2005). A mathematical pattern can be defined as any regularity that can be anticipated, typically encompassing numerical, spatial, or logical relationships (Mulligan & Mitchelmore, 2009). There are many indications that an understanding of pattern and structure is important in early mathematics learning (Mulligan, 2002). The teaching of Number Patterns in Grade 7 gives the learners an opportunity to think critically and logically about solving problems within and outside the classroom. The inclusion of Number Patterns in the mathematics curriculum of Grade 7 is to prepare learners for pre-algebraic thinking in the classroom (Mulligan & Mitchelmore, 2009).

1.9.3 Teaching

Teaching involves engaging with learners to facilitate their comprehension and application of knowledge, concepts, and processes. Teaching means to involve learners in the learning process. Therefore, teaching entails actively involving learners in the construction of knowledge. A teacher must possess not only expertise in subject matter but also an understanding of how learners learn and how to encourage them to become active learners (Christensen et al., 1991). Effective teaching necessitates a dedication to a systematic understanding of the learning process. Teaching mathematics encompasses not just the transmission of mathematical knowledge and skills, but also the transformation of learners to fulfill their needs as they become active constructors of their own and others' knowledge. Fundamentally, teaching is about establishing the pedagogical, social, and ethical conditions that empower learners to take responsibility for their learning, both individually and collectively (Christensen et al., 1991).

1.9.4 Teachers' experiences

The experiences of teachers are built over a period of years in their classroom practice as professional teachers. These experiences arise from the interactions with learners, colleagues, and all stakeholders within the various institutions where they teach. The value systems and beliefs held by teachers significantly influence their experiences. The experiences of teachers can also be influenced by the environment they teach in and the social and economic background of both the teacher and the learners in the classroom. The professional experience of a mathematics teacher can also be gained through professional workshops, training, and networking with other mathematics teachers. In the mathematics classroom, teachers' lived experiences determine the teaching methods, learning materials, resources, and learning activities (Mortazavidah et al., 2017).

1.9.5 Structure of the study

The research is structured into six chapters. Each chapter reflects the experiences of seventh-grade teachers in teaching Grade 7 learners on Number Patterns in mathematics. All chapters are centred on the primary research issue: Teachers' Experiences of Teaching Number Patterns to Grade 7 learners in KwaZulu-Natal. A brief overview of each chapter is provided below:

CHAPTER 1: This chapter serves as an introduction, presenting the study along with its rationale and background. It continues by discussing the focus and location of the research. Additionally, it outlines the research questions that will be addressed as the study progresses. Furthermore, the chapter defines key terms that are commonly utilised throughout the entire research

CHAPTER 2: This chapter reviews the literature concerning teachers' experiences in mathematics instruction. Literature emphasises motivation for conducting this study. The chapter focuses on the challenges that teachers encounter while teaching mathematics (Number Patterns) within a particular educational context. Additionally, it explores various teaching experiences across different curricula that contribute to understanding teachers' experiences in teaching Number Patterns in Grade 7.

CHAPTER 3: This chapter examines the theoretical framework of the study, which is based on social constructivist theory and the concepts that support the research.

CHAPTER 4: The fourth chapter examines qualitative research design, utilising face-to-face semi-structured interviews and classroom observations as methods for data generation. Interpretive research designs aim to interpret the data generated. The chapter addresses the selection of participants and the nature of the sample they represent. It includes a table detailing the biographical information of each participant with assigned pseudonyms. Additionally, there is an analysis of how the data generated from each participant was processed. Ethical considerations are also addressed in this chapter.

CHAPTER 5: The fifth chapter provides an analysis of data, themes, and a discussion regarding the findings derived from the data. The themes that surfaced during the data generation process are meticulously analysed and transcribed. The generated data helps address the experiences of teachers in teaching Grade 7 learners about Number Patterns. Additionally, the theoretical framework is employed to elucidate the findings and critically examine the assumptions that underpin the experiences of Grade 7 mathematics teachers.

CHAPTER 6: This final chapter provides a summary of the study and its themes. Additionally, it offers recommendations derived from recent research and identifies the gaps that could be addressed by these recommendations for future research. The chapter concludes with reflections based on teachers' experiences in teaching Grade 7 learners on Number Patterns.

1.10 CONCLUSION: This section delineates the importance and relevance of a study of this kind. All essential terminology and novel techniques contributing to the study's success are meticulously examined and articulated. Further sections essential for the progression of the research, including the literature review and theoretical framework, will be addressed in the following chapters.

CHAPTER TWO LITERATURE REVIEW

2.1 INTRODUCTION

In the first chapter, the research study was presented, and the study's location was described. This study is grounded in an understanding of Number Patterns as a subject within the primary school mathematics curriculum and understands how it is taught in Grade 7. The research explores the experiences of teachers who teach Grade 7 learners Number Patterns in KwaZulu-Natal. To enhance the study's relevance and progress, the second chapter is dedicated to a literature review that provides deeper insight into teachers' experiences concerning the teaching of Number Patterns to Grade 7 learners in KwaZulu-Natal. The literature review assisted in guiding and strengthening the study by identifying gaps and acknowledging local and international contexts, as well as the areas that have shaped the teaching of Number Patterns in previous studies.

The review of the literature was done according to the following headings: the incorporation of number patterns into the primary school curriculum; impact of mathematics teachers' experiences on teaching; effects of mathematics teachers' experiences of anxiety on learners' learning; impact of teachers' experiences on teaching mathematical modeling; Effects of professional experiences on in-service teachers' teaching on learners in the United States of America; impact of blended teaching experience on learners in mathematics classroom; Effects of experience of mathematics teaching and play in the classroom; experiences of teachers' roles and responsibilities in learner-centred STEM classroom; effects of experiences of teachers' in their teaching identity on learners' learning; impact of teachers' application experiences on mathematical concepts in mathematics learning in the classroom; experience of teachers as facilitators in the mathematics classroom; importance of number patterns; teaching number patterns in South Africa; and conclusion of the chapter.

2.2 THE INCORPORATION OF NUMBER PATTERNS INTO THE PRIMARY SCHOOL CURRICULUM

Algebra in primary school mathematics curricula around the world has a long history of debate on the inclusion of the algebraic concept. Venkat (2019) highlights that many learners struggle with basic arithmetic operations, indicating a need for early algebra introduction into the primary curriculum. According to Venkat (2019), as part of the Wits Maths Connect project, which focuses on primary mathematical education in South Africa, particularly in disadvantaged schools. The

study was conducted in ten partner primary schools serving disadvantaged learners from Grades 1-3. The study found that learners' ability to use appropriate methods to calculate answers improved significantly through a 'key model and connection' approach. This approach emphasises making sense of mathematical problems and developing algebraic thinking (Venkat, 2019).

Venkat (2019) suggests that early algebra learning can be improved by focusing on developing mathematical knowledge, enhancing teachers' understanding of algebraic concepts, and pedagogical practices. This study emphasises the use of models and connections through visual representations and real-world examples to illustrate mathematical relationships.

A study conducted by Porteus and Mostert (2022) in South Africa on exploring the use of number pictures in a mathematics classroom involved 30 Grade 2 learners from a mainstream primary school. The study found that learners who used number picture representations demonstrated improved understanding of Number Patterns and relationships, including place value and equivalence. The study suggests that incorporating number picture representations into the primary curriculum can enhance learners' understanding of Number Patterns and relationships, promoting a deeper understanding of mathematics (Porteus & Mostert, 2022).

Bowie and Graven (2024) used a case study design to explore the use of games to develop number sense in an early-grade Maths club. The study involved 20 Grade 1-3 learners from a low socio-economic background. The study found that learners who participated in Maths clubs using games demonstrated an improved sense of mathematics, including understanding of Number Patterns and relationships. Bowie and Graven (2024) suggested that incorporating games into the primary curriculum can promote learners' number sense, including Number Patterns. The studies by (Venkat, 2019; Porteus & Mostert, 2022; Bowie & Graven, 2024) highlighted the importance of incorporating Number Patterns into the primary school curriculum in South Africa, which enhances the development of number sense in learners.

Bodanskii (1991) stated that in the former Soviet Union, the majority of mathematics teachers, policy makers, and researchers believe that algebra should become part of the primary school mathematics curriculum. According to Bodanskii (1991), young children (9-10 years) can learn to think of mathematical operations as a function rather than as mere computation of numbers in

the classroom, which forms the basis of Number Patterns. Carragher et al. (2006) conducted a study in Australia that focused on primary school learners on the emergence of algebra as a generalisation of arithmetic. The study involved 120 learners from Grades 3 to 6 (ages 8-12) from three primary schools. The researchers used Surveys, Clinical interviews, Classroom Observations, and Task-based assessments. The findings of the study showed that learners demonstrated algebraic thinking in Grades 5 and 6. The study also indicated that learners' understanding of variables and patterns improved with age. The learners struggled with abstract representation and preferred the concrete and visual approach.

A study conducted by Bodanskii (1991) in the Soviet Union emphasised abstract algebraic thinking and the use of primary quantitative methods, while the study conducted by Carragher et al. (2006) in Australia focused on concrete, practical problem-solving methods. Carragher et al. (2006) found algebraic thinking in primary school learners, while Bodanskii (1991) reported on algebraic thinking in secondary school learners. The two research studies highlighted the significance of a concrete and visual method for the abstract representation of algebraic thinking.

Carragher et al. (2006) focused on conceptual understanding of early algebra, exploring how learners develop algebraic thinking through problem-solving and representation. Bondaskii (1991), on the other hand, investigates the effectiveness of using multiple representations (diagrams, tables, equations) to solve algebraic word problems. The pedagogical approach used by Carragher et al. (2006) was more contextualised and problem-based for early algebra, while Bondaskii (1991) suggests using multiple representations to support learners' algebraic thinking.

In the context of the South African classroom, teachers can incorporate real-world, contextualised problems to develop learners' algebraic thinking. The use of various representations (diagrams, tables, equations) to support learners' understanding of algebra relationships creates a more comprehensive and engaging early algebra curriculum, preparing learners for success in mathematics and beyond. Teachers can emphasise functions and generalisations to promote a deeper understanding of algebraic relationships.

There was growing evidence indicating that the way arithmetic was taught in primary schools did not adequately support the algebraic reasoning anticipated at the secondary school level.

Consequently, there have been calls to incorporate algebra into the primary school curriculum. However, this concept of ‘early algebra’ is not meant to imply ‘algebra early’; it is not merely a matter of substitution arithmetic with algebra or introducing algebra to primary grades (Carragher et al., 2006). Instead, early algebra represents a pedagogical approach to teaching and learning arithmetic that emphasises the structures and patterns inherent in arithmetic. For instance, the fact that ‘five plus two’ yields the same results as ‘two plus five’, and that this holds true for all pairs of numbers, illustrates the commutative property of addition. Proponents of early algebra do not expect primary school learners to recognise that $a + b = b + a$ (for all whole numbers a, b), but they do anticipate an understanding of the commutative property of addition within the context of arithmetic. Therefore, this concept has been intentionally labeled as ‘early algebra’ or ‘algebraic reasoning’ to differentiate it from ‘algebra’ as it is understood at the secondary level (Carragher et al., 2006).

Over the past fifteen years, there has been significant research in mathematics education focused on clarifying the meaning of ‘early algebra’ along with an increasing sophistication in its interpretation and application (Kieran, 2004; Radford, 2010). Kaput and Blanton (1999) refer to the process of “algebrafying primary mathematics”. In this framework, algebra is viewed as generalised arithmetic. Van Amerom (2003) characterised early algebra as the point at which “arithmetic activities are infused with algebra meaning, with the aim of highlighting their algebraic nature”.

The implementation of Kaput’s model in the context of South Africa requires adequate resources, including trained teachers, materials, and infrastructure. In rural resource-constrained schools, these requirements might be challenging to meet. Teachers need training and support to effectively implement Kaput’s model, which might be challenging in South Africa given the existing teacher workload and limited professional development opportunities. Curriculum and Assessment Policy Statement (CAPS) emphasises patterns and algebra, but might not explicitly align with Kaput’s three strands. This could lead to confusion or difficulty in implementation. The first strand of Kaput’s model, which is generalisation and arithmetic reasoning, is highly relevant, as Grade 7

Learners are developing arithmetic skills and exploring Number Patterns. The second strand is relevant, as Grade 7 learners are introduced to functions and relationships in algebra. Strand three might be less emphasised in Grade 7, as learners are still developing foundational algebraic concepts. To implement Kaput's model in a South African classroom, teachers can use local, relevant examples to illustrate algebraic concepts while focusing on building foundational arithmetic and algebra concepts through flexible, resource-efficient teaching methods. Kaput et al. (2007) provided a detailed framework for considering the various elements of algebra by referring to two aspects and three strands:

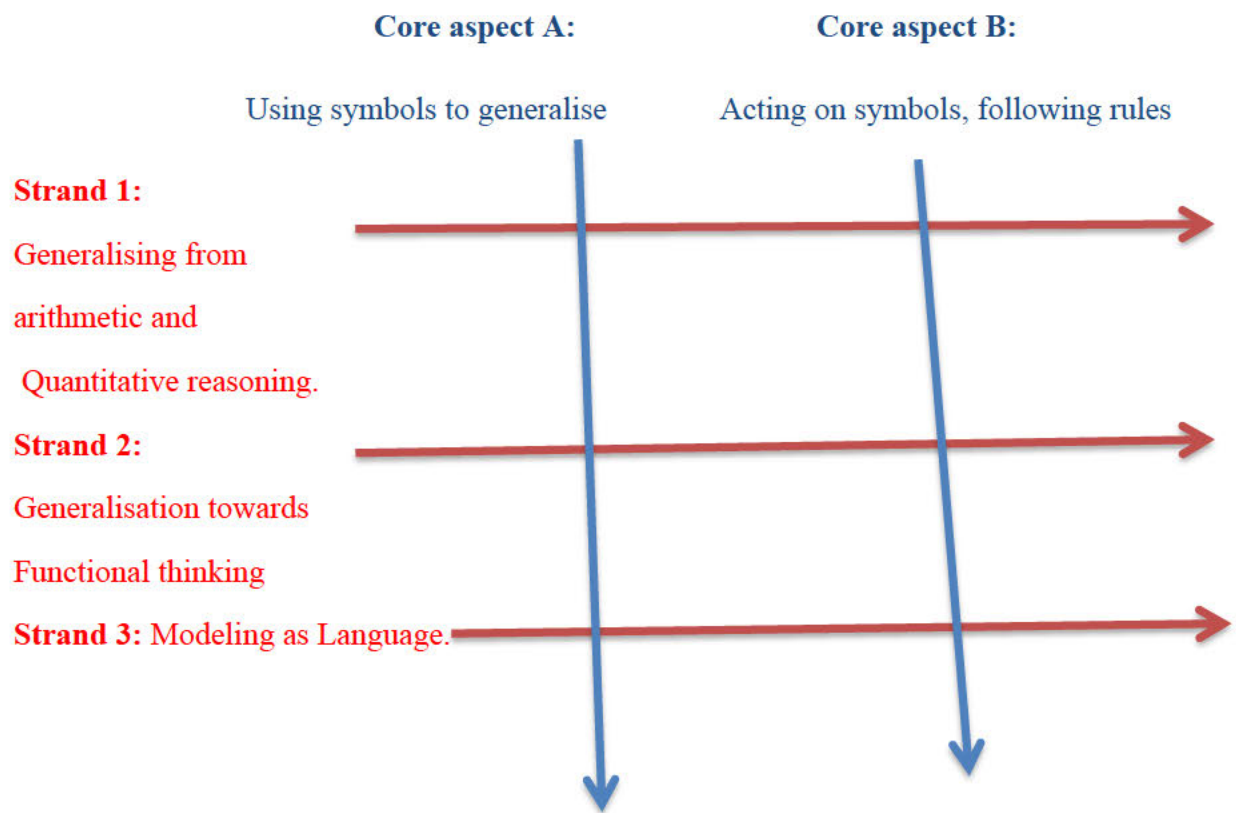


Figure 2.1 Core Aspects and Strands of Algebra

The Core Aspects of Algebra:

Core Aspect A: Generalising and formalising using symbols

This element concentrated on the generalisation of patterns and their interrelations, as well as the formal representation of these patterns through algebraic symbols. It encompasses the recognition of similarities and frameworks within mathematical contexts.

Core Aspect B: Acting on symbols following guided rules

This aspect generally deals with rules governing the manipulation of symbols, which are fundamental to algebraic reasoning.

The Strands of Algebra:

Strand 1: Building meaning for symbols and operations, understanding quantitative relationships

- This strand emphasises the understanding of symbols, operations, and expressions in algebra.
- It focuses on representing and analysing quantitative relationships between variables in algebra.

Strand 2: Functional thinking

- This strand involves studying relationships between variables in algebra, including functional relationships and graphs.

Strand 3: Modelling

- This strand applies algebraic thinking to model real-world situations and solve problems.

Kaput et al.'s (2007) framework emphasises the significance of algebra as a means for generalisation, formalisation, and reasoning about relationships in algebraic thought. By incorporating these essential elements and strands, teachers can develop a thorough algebra curriculum that equips learners for advanced mathematical studies and practical applications. Kaput et al. (2007) note that it is commonly accepted in mathematics curricula that Core Aspect

A typically comes before Core Aspect B, with the latter traditionally being the primary focus of abstract algebra, as encountered in numerous secondary schools. The initial two strands in this classification of early algebra address the two forms of generalisation that are fundamental to algebraic thinking: generalising arithmetic and generalising towards the concept of function. The third strand pertains to modeling processes where scenarios are comprehended and interpreted through algebraic reasoning and terminology. Kaput et al. (2007) identified a facet of algebraic modeling as ‘algebrafying arithmetic problem’, where the limitations of a specific problem are eased to investigate its more generalised form. Kaput et al. (2007) clarify that there are intersections among the strands and offer valuable illustrative examples pertinent to the early grades strand.

2.3 TEACHERS’ EXPERIENCES

2.3.1. Impact of mathematics teachers' experience on teaching

A research study was carried out by Matlala and Wessels (2015) in the Gauteng province of South Africa, involving 15 mathematics teachers from 10 secondary schools. The focus was on the experiences of these teachers regarding the implementation of problem-solving methods in secondary education. The researchers employed semi-structured interviews, observations of mathematics lessons, and document analysis, which included teachers’ lesson plans and worksheets. The findings indicated that the teachers voiced concerns regarding their capacity to teach problem-solving effectively.

The study by Matlala and Wessel (2015) identified that the concerns of the teachers in the study were rooted in teachers’ attitudes and teaching strategies. The teachers used outdated and ineffective methods, and insufficient learner-centred approaches. The study also showed that a language barrier exists when learners fail to understand the teacher, since English was the second language (Matlala & Wessels, 2015). Limited individual attention and increased disciplinary challenges due to overcrowded classrooms were also causes of the teachers’ concerns. The experiences of secondary school teachers focused on the development of learners’ understanding and skill in using symbolic notations to reason and describe concepts in mathematics, such as equations, inequalities, functions, and expressions. Despite the long hours teachers spend teaching, learners still struggle to master basic school algorithms or apply mathematical concepts correctly in the classroom (Matlala & Wessels, 2015). The study focused on secondary school teachers and

problem-solving across the mathematics curriculum, which was not directly on a specific concept. In their research, Matlala and Wessels (2015) determined that the experiences of mathematics teachers were influenced by their own secondary school education, which adversely affected the performance of learners in the classroom. In the context of Grade 7 mathematics teachers, similar patterns of inadequate resources, overcrowding of learners, and outdated teaching strategies and approaches have become hindering factors for teaching and learning of mathematics in primary school.

As noted by du Plessis (2020), a research study was carried out regarding teachers' experiences with the learner-centred approach to teaching in Western Cape Province of South Africa. The study involved 20 teachers from five secondary schools, with experience ranging from 5 to 20 years of teaching. The study showed that every teacher has his/her own teaching philosophy derived from years of experience in the classroom context. Most of the teachers understood the concept of learner-centred but struggled with implementation. The study gave a general view of teachers' experiences within a particular teaching method and not directly with a specific concept in mathematics. Shkedi's (1996) perspective of teaching assumes that anyone can be a teacher if only they are endowed with appropriate personal characteristics derived from their experiences, and that teaching is not a profession of proficiency. Teaching is dependent on personal experience, which is passed on by means of imitation (Shkedi, 1996).

According to Mortazavidah et al. (2017), the experiences that teachers have in their lives influence the teaching methods, learning materials, resources, and activities they utilise in the classroom. These lived experiences significantly impact teachers' educational philosophies, the strategies they select, their classroom management techniques, their interactions with learners, their interpretation and execution of the curriculum, as well as their methods of assessment and evaluation. Mortazavidah et al.'s (2017) study in rural primary schools in Iran focused on how teachers manage teaching in a multi-grade classroom and the challenges they face. The study was based on teaching and learning methods juxtaposed against the experience of teachers. The study involved 20 teachers from rural primary schools with 5 to 20 years' teaching experience. Findings showed that teachers used traditional methods of teaching (textbook-based and lecturing) and facilitated

little learner involvement in the lessons. The findings indicated that teachers' background and lived experiences affected their teaching in the classroom.

Many teachers are products of traditional education systems, lacking exposure to constructivist approaches during their training (Luneta, 2022). This results in a reliance on familiar, teacher-centred strategies. Teachers resist change to stay in the comfort of established routines, and the fear of increased workload can hinder the adoption of new methods (Putwain & von der Embse, 2019). For instance, in South Africa, some teachers struggle to implement learner-centred approaches due to large class sizes and insufficient resources (Tibane et al., 2024). Constructivism emphasises active learning, problem-solving, and contextual relevance (Vygotsky, 1978). Traditional methods conflict with these by prioritising passive reception of knowledge. Teacher-centred approaches neglect learners' prior knowledge and social contexts, reducing engagement (Saira & Hafeez, 2021). Professional development, resource allocation, and policy flexibility can bridge gaps, aligning practices with constructivist ideas. Standardised exams emphasise rote learning, discouraging risk-taking with innovative methods (Hu, 2024). Overcrowded classrooms and limited materials make interactive teaching challenging and force teachers to adopt traditional methods.

Research carried out by Beswick and Goos (2012) in Australia examined primary and secondary school teachers' beliefs, knowledge, and classroom practices. It was discovered that teachers often engaged in professional learning programmes that were grounded in their real classroom experiences. The study involved 12 primary and 12 secondary school teachers, with teaching experience ranging from 3 to 25 years, from both government and private institutions. The researchers employed a mixed-methods approach, including surveys, semi-structured interviews, and classroom observations. The study's findings indicated that teachers' pedagogical content knowledge (PCK) and content knowledge varied, affecting their classroom practices. Teachers' beliefs reflected their classroom practices and variability in their teaching methods.

The methods and skills of teachers teaching any subject enable them to be more flexible in exploring new ideas and ways of delivering mathematics content to learners in the classroom. Carl (2012) observed that the contextual factors surrounding a particular school, the in-service training,

and the social interaction of teachers during workshops, seminars, and mathematics conferences, during which teachers share and discuss ideas, also contribute positively towards the development of teachers' mathematical content or pedagogical knowledge.

The process of knowledge construction among mathematics teachers stems from their experiences with content and their pedagogical comprehension of teaching. Effective teaching and learning, which fosters an understanding of mathematical concepts in the classroom, can take place when teachers reflect on their pedagogical knowledge and practices (Sahlberg & Hasak, 2016). Successful curriculum implementation in a specific context necessitates the experiences of teachers (Nordhaus, 2010).

Effective teaching fundamentally revolves around the most effective methods to achieve the intended learning outcomes through various educational activities (Hattie, 2012). Early investigations into this subject were primarily concentrated on specific traits of teachers or distinct elements of the teaching process. The depiction of teachers' behaviours as rational and reflective has propelled research into the cognitive processes, planning, and theorising that teachers engage in (Zeichner & Liston, 2014). Teachers are required to make decisions during the teaching process (Zeichner & Liston, 2014). This emphasis on interactive decision-making has been enhanced by studies examining teachers' routines, established rules, and patterns of practice (Kennedy, 2016; Goodwin, 2019). The growing focus on the integration of research concerning teaching and learning has introduced an additional layer. Effective teaching is now perceived through a dual lens, where the learning outcomes are influenced by actions and thoughts of the learners, which are significantly shaped by the teacher's conduct and verbal communication within the classroom.

A major trend that has been developing in teaching is the shift away from authoritarianism to a learner-centred approach. The traditional teacher-centred approach to teaching, predominantly used by mathematics teachers from their past experiences, is now being replaced by a plethora of alternative theories that are taking us forward in terms of teaching methodologies. Some are in harmony and compatible, and others are not so compatible. Abel (1997) gives the label of "Mediational/experiential" to a consistent grouping of theories, which embraces Feuerstein, Vygotsky, and Piaget in their learning theories.

Table 2.1 Traditional approaches and Mediatlional/Experiential approaches

	Traditional	Mediatlional/Experiential
PURPOSE	Knowledge acquisition	Attitude/cognitive/ behavioural
ASSUMPTIONS	Change: rationality through standardisation	Change: rational, emotional, and Socio-cultural through awareness and experience.
CONTENT	Public, given, content knowledge and espoused theories. Theory and practice: Discrete and implicit.	Besides traditional, also personal, problematic, process-orientated knowledge; Espoused and theories-in-use together with outcomes. Theory and practice: Explicit and integrated.
PROCESS	Didactic and abstract Non-life related Individual Teacher as expert Learners are passive and subordinate. One directional. Not supported by appropriate text.	Dialectic, meditational and experiential. Life-related. Collaborative, holistic and personal. Teacher as facilitator/mediator. Learner active agent. Multi-directional. Supported by appropriate meditational text.

As noted by Nyaumwe et al. (2004, p. 33), traditional methods, characterised by “teacher-centred teaching techniques that fail to foster learners’ conceptual understanding of mathematics,” have faced criticism for their inability to promote problem-solving abilities among learners. These teaching strategies, which primarily rely on teacher-led discussions, lack sufficient questioning, dialogue, or opportunities for individual comprehension development. Conversely, a learner-centred teaching methodology is designed to assist learners in cultivating mathematical reasoning and encourages them to view the teacher as a facilitator who aids in their understanding of mathematics, while also creating contexts that enable them to derive meaning from mathematical concepts (Brodie, 2006; Yashkewich, Mji & Wessels, 2005).

The learner-centred approach is more challenging to implement in practice than it seems in policy. Chisholm and Leyendecker (2008) observed that learner-centred education is among the most widely adopted concepts; however, it is quite challenging for it to become established in the classroom. This approach necessitates that teachers possess a diverse set of skills, along with a solid understanding of mathematics content. It is advisable to employ a range of teaching methods and styles, as this can “promote adaptability and lifelong learning in the teaching-learning process” (Vaughn & Baker, 2001, p. 610). In his foundational definition of pedagogical content knowledge, Shulman (1986, p. 9) states that “there are no single most powerful form of representation; the teacher must have at hand a veritable armamentarium of alternative forms of representation.”

Taylor and Taylor (2013) stated that many teachers lack a solid grasp of mathematics content, with studies indicating 79% of Grade 6 teachers have knowledge below the curriculum level. Insufficient training in learner-centred approaches leads to reliance on traditional, teacher-centred methods (Luneta, 2015). Overcrowded classrooms and inadequate materials (textbooks, technology) hinder interactive teaching (Tibane et al., 2024). Rural schools struggle with learner-centred approach due to language barriers, as English-medium instruction complicates concepts explanation (Robertson & Graven, 2020). According to Mbonambi and Bansilal (2014) limited access to professional development opportunities exacerbates skill gaps. The use of rote-learning tasks, neglecting critical thinking (Luneta, 2015), and high workloads reduce time for personalised feedback to learners (Tibane et al., 2024). The contextual factors identified by these studies hinders South African Grade 7 mathematics teachers to adopt learner-centred methods.

According to Shulman's (1986) definition, the emphasis is on the importance of teachers having various means to represent the subject matter, to render it meaningful for their learners. Common strategies in mathematics education include direct teaching, cooperative learning, and problem-based teaching. Additionally, innovative teaching techniques that can be incorporated into teachers' practices include the use of manipulatives, real-life applications, the integration of technology, and games (Moore, 2013).

Manipulatives can effectively create an external and more tangible representation of the mathematical concepts being taught (Moore, 2013). Another pedagogical strategy that enhances learners' success in mathematics is the incorporation of games into the teaching process (Moore, 2013). Employing games in mathematics teaching fosters the development of mathematical thinking and knowledge (Nisbet & Williams, 2009). Ke and Grabowski (2007, p. 256) assert that "playing games plays important roles in a child's psychological, social, and intellectual development." Boaler (2008, 2016) recommends that teaching should leverage rich mathematical activities with significant intellectual demand, rather than relying on rote memorisation, to cultivate a positive attitude towards mathematics. Furthermore, studies suggest that linking mathematics to real-world situations provides teachers with the opportunity to make mathematics more accessible and enjoyable for learners (Miller & Kaffar, 2011).

Mathematics serves as the foundation for numerous disciplines. As noted by Boaler (2008, 2016), learners' proficiency in mathematics significantly influences their performance in other subjects, as mathematics provides them with four operational skills along with the ability to think flexibly, reason, solve problems, and develop various metacognitive thinking skills. Consequently, from the early years of education, teachers should prioritise mathematics classes and the associated homework. The groundwork for advanced thinking skills in learners can be laid through mathematics assignments given during their primary school years. It is anticipated that primary school teachers will take this into account when assigning mathematics homework, ensuring that the tasks enhance these skills.

Manipulatives are powerful tools in mathematics education; they can be ineffective under certain conditions. Distractions or misuse of manipulatives can disrupt learning (Corwin Connect, 2023).

Learners may struggle to transition to abstract thinking without scaffolding. According to Tjandra (2023), teachers may lack proficiency in integrating manipulatives effectively during the lesson. This can be caused by insufficient or inappropriate materials for implementation, and manipulatives not align with learning objectives (Satsangi & Miller, 2017). Incorrect use may lead to a misunderstanding of the concept (Van de Walle et al., 2018). To enhance the effectiveness of using manipulatives in the classroom, teachers should establish clear rules, start with structured activities, and gradually increase independence as learners gain confidence. Balance manipulative use with abstract problem-solving, and encourage mental math exercises (Peltier et al., 2020). According to Mazo (2024), professional development and peer collaboration on best practices should be encouraged. Teachers should explain the purpose of the manipulatives and involve learners in selection, highlighting success stories (Ponte et al., 2023). Activities in the classroom must be planned efficiently, use pre-organised materials, and integrate manipulatives into routine. Guide learners to reflect on their actions and link manipulatives to abstract concepts (Nash, 2023).

In contemporary society, mathematical reasoning and mathematical abilities are essential across all professions and in every aspect of daily life (Voinea & Purcaru, 2015). Aydin-Guc and Baki (2019) emphasise that mathematics classes ought to equip learners with skills in reasoning, modeling, attribution, communication, and problem-solving. He further indicated that teachers could assist learners in developing these competencies by teaching them fundamental mathematics concepts and the methods for acquiring mathematical knowledge.

As stated by Yuniarti et al. (2017), teachers ought to motivate learners to cultivate innovative concepts while addressing mathematical challenges. However, it is very difficult in mathematics education, where learners begin from the pre-school period to gain these skills and make them permanent with in-class activities alone. Therefore, teachers must take mathematics beyond their class hours and ensure that learners are engaged in mathematics even outside the classroom.

2.3.2. Effects of mathematics teachers' experiences of anxiety on learners' learning

Mathematics teachers' anxiety significantly impacts learners' learning outcomes in both South Africa and Ghana, as studies have shown. Research shows that teacher anxiety can lead to a decrease in learner motivation, interest, and achievement in mathematics learning (Hill, 2016; Amoah-Mensah, 2017). In South Africa, mathematics teachers' anxiety has been linked to poor

performance in mathematics (Mji, 2018). A study conducted by Mji (2018) found that 60% of mathematics teachers reported experiencing anxiety when teaching mathematics, which negatively impacted learner engagement and motivation. Similarly, a study conducted by Spaul (2015) revealed that teacher anxiety contributed to the country's poor performance in international mathematics assessments.

In Ghana, mathematics teachers' anxiety has also been identified as a significant factor affecting learner performance (Amoah-Mensah, 2017). A study conducted by Amoah-Mensah (2017) found that 75% of mathematics teachers experienced anxiety, leading to inadequate lesson planning and delivery. Another study conducted by Ofori (2020) revealed that teacher anxiety negatively impacted on learner confidence and interest in mathematics.

Comparing the two contexts, it is evident that mathematics teachers' anxiety has negative effects on learners' learning outcomes in both South Africa and Ghana. However, there are differences in the prevalence and causes of teacher anxiety. In Ghana, research indicates that Ghanaian mathematics teachers face challenges in integrating ethnomathematical perspectives into teaching, partly due to inadequate cultural examples in curricula and time constraints (Kyeremeh et al., 2025). For example, male teachers highlighted a lack of culturally relevant examples, while female teachers cited gender discrimination as a barrier (Kyeremeh et al., 2025). In South Africa, studies indicated that mathematics teachers often grapple with large class sizes, resource shortages, and insufficient training in learner-centred approaches, exacerbating anxiety (Luneta, 2022; Tibane et al., 2024). A study by Luneta (2022) noted that teachers' limited content knowledge and pedagogical skills contribute to mathematics anxiety. Ghana's challenges lean toward cultural integration, while South Africa's are more systemic (resources, class size).

In cultural perceptions of mathematics, Ghanaians view mathematics as a Westernised subject, potentially alienating local cultural contexts (Kyeremeh et al., 2025). Teachers acknowledge the need to contextualise mathematics but struggle to balance cultural relevance with curriculum demands. Post-apartheid efforts emphasised inclusivity in South Africa, yet cultural perceptions vary regionally. Some communities prioritise rote learning over critical thinking, influenced by historical marginalization (Mabotja, 2025). Ghana's cultural challenges are explicit in curriculum

adaptation, while South Africa's are nuanced, reflecting diverse post-colonial contexts, which creates anxiety.

Systemic pressure in Ghana, such as standardised testing and performance metrics, creates pressure, with limited resources for teacher support (Enu, 2022), while in South Africa, high teacher turnover, an aging workforce of mathematics teachers, and uneven quality of graduates strain the system (Luneta, 2024). For instance, 48% of teachers are over 50 years, with the retirement rate outpacing new qualified hires (Luneta, 2024). South Africa faces structural shortages, while Ghana's pressures stem from assessment systems, which both require policy reforms to reduce workload and improve teacher support to mitigate anxiety. In South Africa, teacher anxiety is frequently ascribed to insufficient training and support (Mji, 2018), whereas in Ghana, it is associated with a lack of resources and unfavorable working conditions (Amoah-Mensah, 2017).

Mathematics anxiety is a feeling of tension and anxiety that interferes with the manipulation of numbers and the solving of mathematical problems in everyday life and academic situations (Moustafa et al., 2021). It's a context-dependent feeling of tension triggered by experiences related to mathematics, such as dealing with numbers, being observed in mathematics classes, or performing tasks involving mathematical concepts (Stella, 2022). Such anxiety, as Ma (1999) notes, can cause learners to avoid mathematics-related courses and careers. The adverse effects of math anxiety can include poor academic performance (Ashcraft, 2002), diminished working memory capabilities (Ashcraft & Moore, 2009), and a low self-assessment of one's abilities (Hembree, 1990). Previous studies have indicated that a primary cause of learners' math anxiety is linked to their early negative interactions with teachers in educational settings (Bekdemir, 2010; Bryant, 2009).

Teachers' anxiety regarding mathematics has an impact on learners' anxiety towards the subject, particularly when certain teaching methods, such as an excessive dependence on rote memorisation instead of fostering conceptual understanding, are employed (Vinson, 2001). Alongside math anxiety, the term math teaching anxiety refers to the feelings of tension and unease experienced by both pre-service and in-service teachers while teaching mathematical concepts, theories, and

formulas, or during problem-solving activities (Peker, 2009). Therefore, while math anxiety and math teaching anxiety are interconnected, they represent two separate setups (Hadley & Dorward, 2011). Teachers may experience math teaching anxiety due to a belief in their inadequacy to effectively teach mathematics to their learners. Nevertheless, they may still possess a high level of confidence regarding their mathematical knowledge. In a study involving 629 in-service elementary school teachers, Hadley and Dorward (2011) discovered that learners in classrooms led by teachers with lower levels of math teaching anxiety achieved greater success in mathematics compared to those whose teachers exhibited higher levels of math teaching anxiety.

2.3.3. The impact of teachers' experience of teaching mathematical modeling (MM)

Mathematical modeling involves creating a mathematical representation of a real-world situation to facilitate predictions or offer insights within the classroom. Teachers acquire the skills necessary to effectively guide their learners in modeling (Blum & Borromeo Ferri, 2009; Cai et al., 2014). Research spanning decades on Professional Development (PD) and teacher knowledge has produced findings in several traditional core areas of school mathematics, such as algebra, rational numbers, and proof of functions, which have been compiled by researchers (Jacobs & Spangler, 2017; Strutchens et al., 2017).

However, there has been less focus on how teachers develop knowledge and skills to facilitate mathematical modeling. Wess et al. (2021) provide a summary of professional competence in teaching, building upon the foundational work of Shulman (1986, 1987), which includes the Teacher Education and Development Study in Mathematics (Tatto et al., 2008) and the Cognitive Activation in Mathematics Classroom and Professional Competence of Teachers (Kunter et al., 2013) project. Researchers examining various modeling perspectives on learning and teaching emphasise the importance of teachers' involvement in modelling tasks and their attention to learner thought processes (Koellner-Clark & Lesh, 2003; Schorr & Lesh, 2003) in their implementation of model-eliciting activities, as well as the contributions of Wubbels et al. (1997) regarding the use of context in Realistic Mathematics Education.

Wess et al. (2021) contend that professional competence in teaching mathematical modeling is distinctive, based on the premise that pre-service teachers are equipped with an understanding of mathematical modeling competencies and the challenges faced by learners; this is supported by a

body of literature that mathematics teachers have empirically and theoretically contributed to (Borromeo, 2018).

In the United States, most in-service teachers have not experienced a focused programme in mathematical modeling. Transitioning from conventional problem-solving to mathematical modeling necessitates “a new set of teaching and learning skills” (Herget & Torres-Skoumal, 2007, p. 385). Some researchers pinpoint teaching skills that may be crucial for effective teaching in general, and particularly vital for teaching mathematical modeling. To exemplify how teachers might perceive general teaching skills as pertinent, I discussed the importance of engaging with learner responses and facilitating group work. These areas of teaching skills appear to be particularly significant for in-service teachers who are teaching mathematics modelling. For instance, in the mathematical modeling competence assessment created by Wess et al. (2021) it is essential for teachers to engage with learner answers to uncover learner difficulties and subsequently assist learner groups in navigating those challenges.

In the context of the South African classroom, with resource limitations, the teaching skills identified by Herget and Torres-Skoumal (2007) in the United States can be applicable with careful consideration. While the core principles of modeling, such as problem-solving, critical thinking, and contextual relevance, are maintained. Practical adaptation of these skills may be necessary due to contextual differences. The transferable skills, like contextual relevance, using locally relevant examples, such as township markets against United States scenarios, can enhance engagement (Bako et al., 2024). The breaking down of complex problems is adaptable, even with limited resources, though digital tools might substitute physical manipulatives (Ponte et al., 2023). Encouraging active participation through group work and peer collaboration can offset resource shortages, leveraging shared learning.

Mathematics teachers in South Africa might need localised professional development to align with curriculum demands (Janse van Rensburg & Oguttu, 2022). In terms of technology integration, U.S classrooms may rely on advanced technological tools (graphing tools), whereas South African schools might use basic materials (chalkboard, local objects).

2.3.4. Effect of professional experiences of in-service teachers' teaching on learners in the United States of America

The professional experiences of in-service teachers play a pivotal role in shaping learners' learning outcomes. Teachers' expertise, developed through years of practice, influenced their teaching strategies, classroom management, and interaction with learners. Recent studies have indicated that teachers' experiences have great influence on learners' learning. A study was conducted by Rockoff (2004) in New York City on the impact of individual teachers on learner achievement. The study focused on teachers' effectiveness through their experiences. The study involved 83000 learners and 2500 teachers from 400 schools, from diverse socioeconomic backgrounds. The study revealed that teachers' experiences had a significant influence on learners in terms of their achievements. The experience of teachers is a significant predictor of learners' outcomes, whereas the levels of teacher education and certification have minimal impact on learners. Teachers with more years of experience tend to have higher-quality teaching practices, leading to improved learners' achievement (Rockoff, 2004).

Similarly, a study conducted by Harris and Sass (2011) in Florida in the United States of America on teacher training, quality, and learners' achievement, involving 144 schools, over 12400 teachers, and over 221000 learners, revealed that teacher experience positively correlated with learners' achievement. The professional development of teachers improved the quality of teacher experience and their influence on learners.

The study used regressive analysis, value-added modeling, learner test scores, and teacher surveys to generate the data findings. The teacher quality created the different variations in learners' test scores, meaning teachers' experiences and the quality of their experiences had a great influence on learners' achievements.

2.3.5. The impact of blended teaching experience on learners in the mathematics classroom

In Indonesia, blended teaching experience was implemented by teachers to enhance teacher quality and learners' learning outcomes (Mulyono, 2018). Research conducted by Mulyono (2018) indicated that Indonesian teachers with experience in blended teaching exhibited enhanced pedagogical skills and a deeper understanding of subject matter, resulting in improved performance among learners. The findings of the study showed that seasoned teachers successfully

incorporated technology into their teaching method, thereby creating a more engaging and interactive learning atmosphere (Mulyono, 2018).

Furthermore, Indonesian teachers with blended teaching experience expressed greater confidence in their teaching capabilities, which had a positive effect on learners' motivation and engagement (Kemdikbud, 2019). According to the Internet Service Management Association, there has been a notable increase in internet usage in Indonesia between 2017 and 2019 (Affan & Thohir, 2020). It shows that Indonesians use the internet in their daily life. The use of the internet among Indonesians is mainly through smartphones. The Indonesian Ministry of Information and Communication stated that Indonesia ranked as the fourth country that actively used smartphones. It was also stated that more than one hundred million Indonesian citizens are active smartphone users. It further proves that Indonesia is one of the countries that actively uses smartphones in daily life.

In South Africa, blended teaching experience has also been implemented to address teacher shortages and improve learner outcomes (Department of Basic Education, 2019). A study conducted by Mestry (2018) found that South African teachers with blended experience demonstrated enhanced teaching skills, specifically in the management of diverse classrooms and the differentiation of teaching. The research indicated that seasoned teachers successfully utilized technology to assist learners with differing requirements (Mestry, 2018).

Furthermore, South African teachers with blended experience reported improved subject matter knowledge and pedagogical content knowledge (PCK) (Shalem, 2016). According to Shalem (2016), the significance of teacher experience is critical for developing PCK, which is effective for teaching and learning in the classroom. In comparing the two contexts, it is evident that blended teaching experience positively impacted teachers' experience and learner outcomes in both Indonesia and South Africa. However, there are distinct differences in the implementation and outcome of blended teaching experiences.

In Indonesia, the focus is on enhancing teacher quality through ongoing professional development and technology integration (Mulyono, 2018). In contrast, South Africa emphasises addressing

teacher shortages and improving learner outcomes through blended teaching experience (Department of Basic Education, 2019).

The difference in focus on blended teaching between Indonesia and South Africa stems from their unique contextual factors such as, infrastructure, policy priorities, resource challenges, teacher preparedness, and cultural and socio-economic factors. Indonesia prioritises expanding access to remote areas via digital platforms (online modules, mobile learning), and teacher training for technology integration (Shoukat et al., 2024). For instance, Indonesia's "Merdeka Belajar" initiative promotes flexible learning models, including blended approaches.

South Africa focuses on addressing resource inequalities (internet access, device availability) and improving foundational skills. Struggles with large class sizes and variable teacher proficiency in technology (Janse van Rensburg & Oguttu, 2022). For instance, South African universities like UNISA emphasise blended learning in distance education, but contact schools face implementation hurdles.

Indonesian research focused on pedagogical skills and subject matter knowledge (Mulyono, 2018), while South African research highlighted the importance of teaching skills, pedagogical content knowledge (PCK), and the management of diverse classrooms (Mestry, 2018; Shalem, 2016). In conclusion, blended teaching experience significantly impacts teachers' experiences and learners' outcomes in both Indonesia and South Africa. While there are differences in implementation and outcomes, the importance of teacher experience in shaping learner outcomes is evident.

In strengthening the teaching of mathematics in Grade 7 through blended teaching, South Africa can adopt Indonesia's context-specific math resources. This localised digital content will allow South Africa to create culturally relevant materials that align with local curricula. The use of workshops, peer mentoring, and in-line mathematics quizzes could enhance South African teachers' technological skills.

2.3.6. The effect of the experience of mathematics teaching and play in the classroom

Mathematics teaching and play are essential components of effective mathematics teaching, especially in primary school. Research has revealed that experiential learning and play-based approaches can enhance learner engagement, motivation, and understanding in mathematics (Hill,

2016; Takahashi, 2017; Bennett, 2018). Reconciling play in mathematics learning with curriculum in South African classrooms requires a balanced approach that integrates playful, engaging methods with structured academic goals. Studies highlight play's role in developing critical thinking, but emphasise balancing it with curriculum demands (Graven, 2025; Bowie & Graven, 2024).

Mixed views exist among teachers on play-integrated mathematics teaching and learning. Some view play as time-consuming, while others value it for its ability to enhance understanding. Professional development on play-based pedagogy is crucial (Janse van Rensburg & Oguttu, 2022). Curriculum and Assessment Policy Statement (CAPS) emphasises conceptual understanding, but the implementation guidelines could better address play. Stakeholders advocate for clearer integration frameworks (Department of Basic Education, 2025).

In the South African context, the experiences of mathematics teaching and play as an approach have been integrated into the curriculum to improve learner outcomes (DBE, 2019). A study by Mji (2018) found that experiential learning approaches increased learner engagement and motivation in mathematics learning in the classroom. However, challenges persisted, including inadequate resources and teacher training (Spaull, 2015).

In the context of Japan, mathematics teaching and play are deeply ingrained in the culture (Takahashi, 2017). Japanese mathematics education emphasises problem-solving and critical thinking through a play-based approach (Hino, 2018). Research by Takahashi (2017) revealed that Japanese learners outperform their international peers in mathematics due to the emphasis on experiential learning.

In the context of Canada, the teaching of mathematics is combined with play through inquiry-based learning (Bennett, 2018). A study conducted by Bennett (2018) revealed that play-based methods enhanced learner motivation and comprehension in mathematics. Furthermore, Canadian research underscores the significance of providing training and support for teachers to ensure effective implementation (Hill, 2016).

The connection between the teaching of mathematics and play can be interpreted in two ways: as ‘mathematics made playful’, which includes games that prominently feature counting, sorting, and various mathematical operations, or as ‘mathematising elements of play’, where the primary focus is on play itself, and a teacher may attempt to integrate mathematical concepts or operations into the child’s play activities (van Oers, 1996). The concept of mathematising is frequently applied when the focus is on children, including preschoolers, as they seek to comprehend different phenomena in their environment, with mathematics becoming an integral part of this exploration (Freudenthal, 1968).

From this viewpoint, the teaching of mathematics to young children should fundamentally rely on their personal lived experiences (such as play) and should aim to enhance these experiences through mathematical exploration (Gravemeijer & Terwel, 2000). Anghileri (2006) proposes that the teaching process requires the teacher to initiate reflective changes, whereby the actions and discussions that occur become explicit subjects for conversation. In essence, the activities that both children and the teacher engage in transform into topics for discussion from a mathematical perspective, contextualised within the activity.

This can be associated with the act of engaging in play, where participants frequently enter and exit the play context to negotiate the meaning and progression of the ongoing play. Play activities, especially role play, can provide valuable teaching opportunities if the teacher is involved and can leverage the mathematical phenomena that arise (van Oers, 1996). The teacher’s role is to enhance children’s interactions with mathematics while also creating a rich environment that presents opportunities to investigate both new and familiar concepts (Wager & Parks, 2016). In this methodology, it is insufficient for mathematical representations and concepts to merely exist within the play; the reflection on and advancement of children’s mathematical thinking relies on the teacher’s capacity to capitalise on these moments. This ultimately relates to the concept of how children learn. Wager and Park (2016), along with van Oers (1996), support the notion that children’s initiatives and explorations are vital, but they also stress that teachers must introduce new content and viewpoints that will broaden the children’s experiences, including their own play (Magnusson & Pramling, 2017).

This indicates that the teaching of mathematics transcends the mere promotion of counting, addition, naming, or the application of measures. Instead, it focuses on enhancing play and assisting children in comprehending the world around them, thereby enabling them to mathematise. As noted by van Oers (1996), a crucial element lies in the inquiries posed by the teacher that motivate children to identify a problem arising during play activities, which aids them in mathematising their play content and resolving the issue through mathematical operations or representations. There are notable findings regarding the correlation between children's learning outcomes and the frequency and duration of their engagement in play-based mathematics activities (Cohrssen et al., 2014). Nevertheless, there remains a lack of knowledge concerning the effectiveness of various teaching methods in relation to play

In alignment with developmental pedagogy, early childhood education is perceived as facilitating children's awareness and their comprehension of the world around them. This encompasses both the introduction of new concepts and the exploration of familiar phenomena in innovative ways. Enhancing children's awareness and understanding can be accomplished through the establishment of sustained shared thinking. This form of pedagogical interaction is defined by 'two or more individuals, who "work together" in an intellectual manner to address a problem, clarify a concept, assess activities, or expand a narrative' (SirajBlatchford, 2010, p. 157). in a scenario where sustained shared thinking is fostered, both participants (the teacher and the children) engage in, enhance, and broaden their thought processes. This type of interaction has been demonstrated to yield beneficial results for children's learning (SirajBlatchford, 2010) and will serve as a guiding principle in our analysis of the implications of various actions taken by teachers.

2.3.7. Experience of Teachers' roles and Responsibilities in Learner-Centred STEM Classrooms

The successful application of innovative teaching methods necessitates a comprehension of the role and responsibilities of teachers with reformed classroom settings. The literature surrounding learner-centred classrooms delineates the roles and responsibilities of teachers in environments that utilise learner-centred pedagogies, which encompass various forms of constructivism and inquiry-based teaching. Keiler (2018) assert that in constructivist classroom, "the teachers' role is to encourage and accept learner autonomy and create a comfortable atmosphere for learner

expression,” thereby serving as facilitators for their learners (p. 418-419). Constructivist teachers exhibit behaviours that starkly contrast with those of traditional teachers, who tend to dominate the classroom and deliver direct routine aimed at the acquisition of content knowledge. Friere conceptualised teachers as collaborators with learners in their quest for agency, rather than as individuals “positioned as enforcers, disciplinarians, and police officers” (Gutstein, 2007, p. 424).

Teachers who adopt democratic STEM pedagogy must learn to distribute authority with their learners, allowing learners to make methodological choices that the teacher supports and implements (Basu & Barton, 2010). Specific instances of research across various learner-centred teaching models highlight recurring themes regarding the effects of learner-centred approaches (Keiler, 2018). Researchers characterise teachers in inquiry-based classrooms as catalysts, primarily functioning through guiding questions (Juntunen & Aksela, 2013). Yukhymenko et al. (2014) state, “in a Project-Base Learning environment (PBL), the teacher is not the information provider or classroom controller. Instead, the teacher facilitates, coaches, and exemplifies effective problem-solving skills for their learners” (p. 102). Tamim and Grant (2013) identified four distinct roles for teachers in PBL classroom: reinforcer, extender, initiator, and navigator.

In the existing literature, teachers in various forms of learner-centred classrooms assume, or are expected to assume, the roles of facilitators and educational managers. To effectively embrace these new responsibilities, teachers must redirect their attention in the classroom from lecturing to assessment. Inquiry-based teachers transition into the role of assessors because “it can assist in diagnosing learners’ prior knowledge, evaluating learners’ comprehension throughout the learning process, guiding strategies, and measuring their understanding and knowledge upon the conclusion of the learning experience” (Kazempour, 2009, p. 56). In other terms, “the facilitator keeps the emphasis on learning, directs the process, calibrates the challenge, and offers suitable feedback to each learner as well as the entire group” (Gordon et al., 2001, p. 171). This shift in focus signifies a substantial departure from previous practices.

Literature highlights several challenges that teachers encounter when adopting learner-centred teaching methods. The identified barriers to transitioning to a learner-centred approach include worries about the time required to complete the curriculum (Boddy et al., 2003; Kazempour, 2009;

Cuevas, 2005; Tamim & Grant, 2013), concerns regarding learners' performance on standardised test (Kazempour, 2009; Cuevas, 2005; Qhobela, 2012; Tamim & Grant, 2013), resistance to moving away from traditional teaching practices (Qhobela, 2012), pressure from colleagues (Lewis, 2014), limited flexibility within the classroom environment (Tamim & Grant, 2013), a tendency to replicate the teaching methods they experienced as learners (Kazempour, 2009; Lewis, 2014), and fear related to managing the classroom effectively (Tamim & Grant, 2013).

2.3.8. Effect of experiences of teachers on their teaching identity on learners' learning

Literature focuses on the reasons teachers provide for resisting implementation of new teaching methods, most of which focus on learners, rather than on what the teachers believe about themselves as they attempt to be learner-centred. The experiences of teachers' teaching identity significantly impact learners' learning in the classroom. Teaching identity refers to teachers' professional self-concept, encompassing their values, beliefs, and practices (Beauchamp & Thomas, 2009).

Teachers with strong teaching identity foster a supportive learning environment (Watt & Richardson, 2017), promote learner engagement and motivation (Day & Gu, 2010), and develop effective teaching strategies to assist learners in the classroom (Conway & Clark, 2003). A study by Watt and Richardson (2017) on teacher motivation and identity in Australia, which analysed 150 studies on teacher motivation and identity through thematic analysis, found that teachers with strong teaching identity reported a higher level of job satisfaction and learner engagement. In contrast, teachers who face challenges with their teaching identity often experience anxiety and burnout during their lessons (Day & Gu, 2010), struggle with classroom management (Conway & Clark, 2003), and exhibit a lack of confidence in their teaching skills (Beauchamp & Thomas, 2009). Research conducted by Day and Gu (2010) indicated that fragmentation of teacher identity, characterised by conflicting values and beliefs, adversely affected learners' outcomes.

Although there are reports indicating teacher stress associated with curriculum reforms that mandate learner-centred teaching, there is limited literature that explores the effects on teachers as they adopt learner-centred method (Lewis, 2014), which is the primary focus of this study. The literature on teacher identity suggests that comprehending the effects of this significant environmental shift on teachers' identities is essential for understanding and influencing their

pedagogical decision-making. Teacher identity, according to Beijaard et al. (2004), documents the diverse meanings of teacher identity in the literature. In the context of this study, the roles of teachers pertain to their actions within the classroom, while their identity relates to their self-perceptions and their roles in the classroom. This research expands upon the assertion made by Grier and Johnston (2009) that “Teacher identity is founded on the fundamental beliefs one holds regarding teaching and the profession of teaching, which are perpetually shifting and developing in response to both personal and professional experiences” (p. 59).

The present study contributes to the existing body of literature by investigating the impact of a specific pedagogy on teachers’ identities as they adapt to a new teaching model. In their review of the literature on teacher identity, Davis et al. (2006) argue that the personal histories and professional experiences of teachers significantly influence their development of professional identity. Although teachers’ experiences are pivotal to their identity formation, these experiences are interpreted within a specific context and are influenced by a community of practice (Freedman & Applement, 2008; van den Berg, 2002; van Huizen et al., 2005). Basu et al. (2009) state, “in use of the term identity, we align ourselves with those who view identity as fluid and constructed socially within communities of practice” (p. 360).

Proweller and Mitchener (2004) argue that learners play a pivotal role in shaping their teachers’ professional identities. In the present study, learners who serve as peer leaders constitute a significant part of the teachers’ communities of practice, thereby enhancing the complexity of the teachers’ professional environment. A considerable amount of research on the development of teacher identity concentrates on pre-service teachers (Merseth et al., 2008; van Huizen et al., 2005) and early career teachers (Davis et al., 2006) across various contexts, whereas the current study encompasses teachers with diverse professional experiences within a specific educational setting. From a different perspective on identity, Cohen (2008) posits that “teachers’ identities are central to the beliefs, values, and practices that guide their engagement, commitment, and actions in and out of the classroom” (p. 80). The existing literature indicates that previous experiences influence teacher identity, which subsequently affects their pedagogical decisions (Eick & Reed, 2002; Rex & Nelson, 2004).

Thus, experiences shape teachers' identities (Proweller & Mitchener, 2004), and teachers' identities affect their experiences as their identities influence their teaching practice. The current study uses this framework of evolving teacher identity to explore the relationships among teachers' classroom roles and responsibilities, the ways they think of themselves as professionals, and their attitudes and beliefs about their learners. It explores the ways that a particular learner-centred teaching model (Keiler, 2018), affects teachers' identities and their classroom behaviors.

2.3.9. The impact of teachers' application experiences on mathematical concepts in mathematics learning in the classroom

A research study was carried out by Julie (1993) in the Netherlands regarding various applications related to the delivery of mathematics content and the fulfillment of the mathematics curriculum. The findings indicated that the individual applications utilised by teachers in the classroom are influenced by their personal experience. The role of applications in mathematics is addressed within the state-mandated syllabus, where the content and concepts of mathematics are referred to as application terms. Nevertheless, in these types of applications, mathematics is employed only after the pertinent content has been thoroughly covered within the concept. The study emphasised the timing of when application-based mathematics should guide classroom activities, learning, and teaching (Julie, 1993). While some focus may be directed towards applications, this typically occurs only after learners have mastered an algorithm, and many learners do not reach this level.

The Netherlands implements a mathematics curriculum that prioritises applications. Freudenthal (1973) provides a rationale for this approach, suggesting that learners should revisit the learning process. Education should not commence with the formal system, which is essentially a final product. Instead, real-world situations or problems are examined intuitively to facilitate their mathematisation. This context makes relevance more comprehensible. Niehaus et al. (1997) explains how this methodology has been advanced in South Africa through the Realistic Mathematics Education (RME) joint initiative between the University of the Western Cape (UWC) and the Freudenthal institute. Christiansen (1998b) distinguishes application situations based on how much of the modeling process is included. The most comprehensive category encompasses an assessment of the model or the application. If reality is a starting point, but no actual evaluation takes place, it is a different situation. If the teacher or the problem statement provides learners with

a system description, so that a simplification in comparison to reality has already taken place, we see this as a different type of activity.

In the South African context, teachers' application experience of mathematical concepts is often hindered by inadequate teacher training (Spaull, 2015), limited resources (Mji, 2018), and high learner-to-teacher ratios (DBE, 2019). According to Mji (2018), South African teachers struggle to apply mathematical concepts due to inadequate training and support. In the Netherlands, teachers' application experience of mathematical concepts is enhanced by comprehensive teacher education programme (Wubbles, 2018), emphasis on problem-solving and real-world applications (Kruger, 2017), and collaborative teaching practices (Breedijk, 2016).

Comparing the two contexts, Netherlands mathematics education is focused on comprehensive teacher education, investing in quality education resources, problem-solving, and collaborative learning. Nevertheless, South Africa grapples with insufficient teacher training, encounters limitations in educational resources, and emphasises conventional teaching methods within its schools. The impact of teachers' practical experience on learners in South Africa is evident, as learners frequently face challenges in mathematics literacy and problem-solving abilities (Spaull, 2015), whereas learners in the Netherlands exhibit high levels of mathematical competence and problem-solving skills (OECD, 2018).

The process of mathematising may have been nearly completed and presented within the problem or exercise. This research has opted to differentiate between word problems that do not resemble previously covered material and exercises that closely align with 'previously covered' types of problems. The study revealed that mathematics can only be understood through a combination of perspectives. It would be overly restrictive to focus solely on, for instance, conceptual understanding, whether regarding mathematical concepts or their application in relation to mathematics (such as the technocratic transformation). Instead, the coding and analysis should be directed towards encompassing all forms of mathematical activity, addressing the values inherent in mathematics. This encompasses all perspectives on the specific outcomes and beyond.

2.3.10. Experience of Teachers as Facilitators in the Mathematics Classroom

Tachie (2022) explores teachers' perceptions about collaboration as a strategy to address key concepts in mathematics, highlighting the role of teachers as facilitators. The study found that peer collaboration among teachers helped identify threshold concepts in mathematics, improving teaching effectiveness (Tachie, 2022). According to Tachie (2022) teachers valued collaboration, citing benefits like shared expertise, improved content knowledge, and enhance pedagogical skills.

The use of collaboration facilitated identification of challenging concepts, promoting target support, and professional development. Tachie (2022) stated that facilitation through collaboration encourages teamwork among teachers to address content gaps and improve teaching practices. Facilitation through collaboration provides structured opportunities for teachers to share expertise and best practices, fostering a supportive environment for their classroom practices and promoting effective teaching and learning (Tachie, 2022).

A study by Moleko and Maphalala (2025) explored teachers' experiences as facilitators using Universal Design for Learning (UDL) in primary mathematics classroom in the Free State Province of South Africa. Moleko and Maphalala (2025) highlighted that using the Universal Design for Learning as a guideline during facilitation enhances teaching and learning, promoting inclusivity and engagement in the classroom. The study identified that teachers reported improved learner participation and motivation, addressing diverse learner needs, and reducing barriers to mathematics learning in the classroom.

Baidoo et al. (2025) investigated in-service mathematics teachers' experiences with the jigsaw method for facilitating fractions. The study involved 70 intermediate-phase mathematics teachers in the Chris Hani East District. The study found that the jigsaw method improved conceptual understanding but has logical challenges, and variable teacher training was noted (Baidoo et al., 2025).

Teachers use various methods and strategies to facilitate mathematics, driven by factors like diverse learning needs, concept complexities, and learner engagement. The use of physical objects, visual representations, and abstract concepts to deepen understanding. Interactive activities and manipulatives to enhance retention and motivation during facilitation encourage

exploration, problem-solving, and critical thinking in the classroom. The studies by Tachie (2022) and Baidoo et al. (2025) showed how teachers can create a supportive and engaging learning environment that promotes mathematical understanding and empowers learners to become confident mathematicians through facilitation and collaboration.

Mahlambi (2023) asserts that teacher-centred assessment approaches create challenges for promoting learner diversity in the classroom during mathematics facilitation. The use of assessment for learning requires more training and support in innovative assessment for learning methods to promote inclusive teaching practices. Teachers' actions during facilitation in the mathematics classroom can provide fruitful learning opportunities for learners (da Ponte & Quaresma, 2016). Strong (2016) emphasises the importance of mathematics conversation in the classroom during facilitation, which enhances learners' learning. The pedagogical awareness of teaching early mathematical skills by teachers helps in developing child-initiated mathematical learning and holistic teaching during facilitation (Parviainen, 2024).

Mezirow (1997) contends that, to promote transformational learning, teachers must help learners recognise and critically evaluate their own assumptions as well as those of others. Taylor (1998) asserts that, in recent times, there has been an excessive focus on the teacher, which has come at the cost of the learner. Taylor (1998) highlights that learners also bear responsibility for both creating the environment and engaging in the process of transformational learning. Mezirow (1997) maintains that it is essential for teachers to offer learners opportunities to actively engage in discourse.

Daloz (1999) aptly employs the metaphor of transformation as a journey, where the teacher acts both as a gatekeeper and a guide for learners embarking on this journey. Change, as Mezirow (1991) asserts, occurs through critical reflection. The ability to critically reflect on one's own assumptions is essential for transforming one's taken-for-granted frame of reference, which is a crucial aspect of learning to adapt to change. Brown et al. (2008) emphasise that reflections and critical discussions support new understandings for teachers. In contemporary classrooms, a significant professional identity can enhance teachers' careers. While existing research on teachers' narratives exists (Moss, Springer, & Dehr, 2008; Smith, Fritz, & Mabalane, 2009), no

studies have been found that focus on teachers reflecting on their teaching and learning experiences as learners in schools, as learners in higher education, and as teachers.

The aim of this research was to explore how teachers' real-life experiences in three distinct phases of their lives, specifically, as school learners, as tertiary learners, and as teachers, have shaped their current teaching practices. Understanding these experiences may aid faculty members in higher education institutions in enhancing course design for their teaching. This section addresses the theoretical frameworks that support this research. It is followed by the methodology employed for the narrative, along with the findings pertaining to the three dimensions of the participants' lives as school learners and teachers. The study concludes with insights and implications for teacher education.

Transformative learning related to teaching occurs when teachers reflect critically on their practices and cultivate diverse viewpoints to enhance their understanding of their methods (Cranton, 1996). It is essential for this to become the actual role of training. Taking this into consideration, the role of training is to assist learners in bringing awareness to their habits of mind regarding their teaching practice (Cranton & King, 2003). When this happens, learners critically examine the assumptions that underlie their practice, as well as the consequences of their assumptions, and they develop alternative perspectives on their practice (Cranton, 1996).

2.4 Importance of Number Patterns

Patterns form the basic part of mathematics, counting in a certain order, drawing objects, the movement of objects in a particular form, and the arrangement of objects in a specific order. The idea of arranging numbers in a particular way creates unique ideas within a learner. The introduction of Number Patterns at the primary level in school mathematics fosters a web of ideas in learners' minds, provides children with the chance to enhance their skills necessary for comprehending relationships in patterns, and ultimately aids in utilising elements to represent relationships (McGarvy, 2013, as cited in Hesman, 2020).

A teacher with a good knowledge of mathematical pedagogy will be able to mediate teaching and learning in the classroom (Barbosa & Vale, 2015). The learning of mathematics is strongly dependent on the teacher and how it is taught. It is necessary to provide teachers with diverse

experiences to extend their mathematical content and didactical knowledge (Barbosa & Vale, 2015). Barbosa and Vale (2015), the influences of teachers of mathematics learning are through their experiences and strategies in the classroom as teachers. Number patterns are the generation and arrangement of numbers using a special sequence.

Patterns are generally designed using a particular set of general rules or an expression. Thinking in mathematics can be done through the generalisation of Number Patterns in the classroom. According to Krygowska (1981, as cited in Jureczko, 2017), the identification of patterns in mathematical activities develops the perception and use of analogy, deduction, the reduction of problems, the assimilation and transformation of data, schematisation, discovering regularities, and generalisation. The process of recognising patterns in any given algebraic expressions may be useful to the learners in connecting ideas (Jureczko, 2017). Guerrero and Rivera (2002) stated that patterns are a kind of rule among the elements of a series of mathematical objects that are constructed. The development of mathematical relationships in concepts can be identified through a sequential pattern, integrating with already existing ideas. Promoting mathematical reasoning and creating links between concepts can be done using patterns (Vale & Cabrita, 2008).

Performing activities in mathematics helps in the development of learners' understanding within a specific domain. Using these activities allows learners to explore and invent new ideas within their cognitive domain. The thinking behind any pattern is based on the concept of understanding, format, and mathematical reasoning. The identification of patterns within a set of cognitive manipulations is the nature of intellect. Problem-solving tasks in patterns challenge learners and demand high mathematical thinking skills that involve communication, conjecture, generalisation, argumentation, and proof (Vale & Cabrita, 2008). Teaching strategies adopted for elaboration on the ideas of patterns should give learners ways through which critical thinking is developed (Vale & Cabrita, 2008). Algebra thinking through patterns creates an opportunity for learners to freely express and develop knowledge. The challenges learners encounter can be connected to insufficient knowledge of mathematical content in the early years.

The nature of mathematics is grounded within the content knowledge, and the ability for learners to comprehend the ideas developed (Garrick et al., 2005). A learner with a good understanding of

patterns develops a better capacity in their thinking ability (Young & Muller, 2015). The question of what patterns are generated and how they are generated helps learners to identify connections between mathematical concepts. Different methodologies of teaching mathematical concepts to learners can help create various cognitive structures with the idea of developing skills needed for mathematical computations (Garrick et al., 2005).

Number Patterns serve as effective tools to motivate learners to investigate significant concepts in algebra, particularly in the context of conjectures and generalisations (Yeats et al., 2004). The use of algebra facilitates the expression of general principles, and examining Number Patterns at the primary school level establishes a basis for developing critical thinking abilities and reasoning skills within the mathematics classroom (Usiskin, 1999; Kaput, 2007). According to Blanton and Kaput (2005), algebraic reasoning is a process in which learners generalise mathematical ideas by observing a set of evidence establishing those generalisations through representations and argumentations in a formal and systematic order.

2.5 Teaching Number Patterns in South Africa

Number patterns and the ability to recognise patterns and relationships between components in any classroom situation are at the heart of mathematics teaching. A study conducted by Chatima and Chikiwa (2021) at the Chris Hani district in the Eastern Cape Province, on the teaching of Number Patterns, concluded that teachers teach Number Patterns using multiple methods in the classroom, which included the use of manipulatives, pictures, and tables. The teachers use more visual objects in teaching generalisation in Number Patterns.

A self-directed study conducted by Ntshangase (2021) focused on the teaching of Number Patterns for Grade 2 learners in KwaZulu-Natal. This research emphasised a participatory learning approach that allowed learners to articulate their thoughts freely. The teacher encouraged learners to recognise patterns across various subjects, including Art, Music, Technology, and Language. To facilitate understanding of patterns, the teacher used visual aids, such as images and drawings, for the Grade 2 learners. A pedagogy that is developed from learners' intuitive understanding of structure can be developed by teachers in the domain of arithmetic (Radford, 2012). According to Radford (2012) cognitive extension at Grade 2 level are made possible through carefully planned

pedagogical approaches to sequencing at the foundation phase. Papic et al. (2011), note that at Grade 2 level learners have already experienced all kinds of patterns.

The literature review reveals that there was limited understanding of teachers' experiences of teaching Number Patterns in primary schools. This then creates knowledge gap in understanding teachers' experiences and challenges, insufficient information on effective teaching strategies and practices used during the teaching of Number Patterns in primary schools. Hence, there is need for conducting this current study. This current study can inform teacher education programmes and professional development training on teaching practices and learner outcomes in mathematics learning in the classroom. This study aims to enhance the development of theories in mathematics education; it seeks to explore the connections between teacher experience, teaching methods, and learner outcomes by investigating the roles of teachers, their self-efficacy, and their confidence in teaching Number Patterns at the primary school level; it also addresses the challenges faced by teachers in Grade 7 mathematics education and considers the effects of educational policies and reforms on mathematics teaching in primary schools. Furthermore, conducting this research on teachers' experiences with teaching Number Patterns in Grade 7 can help bridge the knowledge gap, inform educational practices, and contribute to a deeper theoretical understanding of mathematics teaching and learning.

2.6 CONCLUSION

The motive of this chapter has been a review of the related literature regarding teaching experience of teaching Number Patterns to Grade 7 learners. It also acknowledges the inclusion of algebra into the primary curriculum and the various published research on early algebra in South Africa. The chapter also talks about the experiences of teachers across primary, secondary and higher education, on content and pedagogical experiences of mathematics teaching. The importance of Number Patterns in the mathematics curriculum and its impact on learners' current and future studies was also discussed. The literature also viewed how Number Patterns are taught in the primary school in South Africa, which will increase the level of understanding of teachers' experience in teaching Number Patterns. The next chapter discusses the theoretical framework on exploring teachers' experience of teaching Number Patterns to Grade 7 learners in KwaZulu-Natal.

CHAPTER THREE

THEORETICAL FRAMEWORK

3.1 INTRODUCTION

This chapter presents the theoretical framework underpinning the research on teachers' experiences of teaching Number Patterns to Grade 7 learners in KwaZulu-Natal. The purpose of this chapter is to establish the conceptual foundation for understanding the complexities of teaching Number Patterns, and to position the study within Vygotsky's social constructivist theory. Vygotsky's social constructivist theory posits that knowledge is constructed through social interactions and collaborative efforts between individuals (Vygotsky, 1978). In the context of teaching Number Patterns, this theory suggests that learners construct their understanding of mathematical concepts through interactions with their teachers, peers, and environment. The Zone of Proximal Development (ZPD), a key concept in Vygotsky's theory, highlights the importance of scaffolding and guidance in facilitating learners' mathematical development.

This study is situated within this theoretical framework, recognising that teachers play a crucial role in shaping learners' understanding of Number Patterns through social interactions, scaffolding, and guidance. By exploring teachers' experiences of teaching Number Patterns, this research aims to gain insight into the ways in which teachers facilitate learners' construction of mathematical knowledge, and to identify potential areas for improvement in teaching practice.

Vygotsky's social constructivist theory provides a lens for understanding the social and collaborative nature of teaching Number Patterns. This study draws on Vygotsky's theory to explore how teachers' experiences, beliefs, and practices influence learners' construction of mathematical knowledge, and to explore ways in which teachers can optimize their teaching approaches to support learners' mathematical development. This chapter starts with a brief explanation of the theoretical framework, to discuss the social constructivist theory. It further discusses the general application and implication of the social constructivism on teachers' experiences of teaching. As a way of positioning the study within the framework, the chapter

further explores the significance and concepts of the social constructivist theory pertaining to Number Patterns.

3.2 THEORETICAL FRAMEWORK

A theoretical framework consists of a collection of concepts, theories, ideas, and assumptions that aid in comprehending a particular phenomenon or issue. It can also be described as a synthesis of these concepts that assists researchers in designing and executing their research, as well as in interpreting their results. It elucidates the connection between variables, highlights deficiencies in current knowledge, and directs the formulation of research questions and methodologies to fill the identified gap (McMillan & Schumacher, 2010). The aim of the theoretical framework is to establish a foundation for comparing the results of the present study with previously established theories into the research, and assists in the choice of research methodology, data generation, and data analysis (McMillan & Schumacher, 2010).

Theories are developed to elucidate, forecast, and comprehend phenomena and, in numerous instances, to question and broaden current knowledge, constrained by critical bounding assumptions. The theoretical framework serves as the foundation that underpins or supports the research study. According to Anfara Jr and Mertz (2014), theories are a set of interrelated constructs, definitions, and propositions that present a systematic view of phenomenon by specifying relations among variables, with the purpose of explaining and predicting phenomenon. In other words, it is essential for this research to embrace a theory that will develop knowledge for teaching Number Patterns in Grade 7, elucidating and forecasting the experiences of teachers within the classroom.

3.2.1. The social constructivist theory

The social constructivist theory is often attributed to the work of Lev Vygotsky who was a psychologist in the 20th century. The constructivist theory posits that individuals create their own comprehension and knowledge of the world by engaging with experiences and reflecting on those experiences (Olorode & Jimoh, 2016). According to Wnet (2004), newly encountered ideas must be harmonised with the existing ideas and experiences that one already holds. Constructivist theory is premised on four key concepts in the development of knowledge in the classroom. These

concepts are zones of proximal development (ZPD), scaffolding, collaborative learning, and mediation.

The zone of proximal development (ZPD) is a concept within social constructivist theory that denotes the spectrum of knowledge and comprehension a learner can attain with the assistance of a more knowledgeable individual (Vygotsky, 1978). The ZPD is the point where learners can learn and grow with the support of a teacher, peer, or mentor. In the context of teaching Number Patterns, the ZPD is crucial. It implies that teachers should be able to identify the learner's current level of understanding and provide scaffolding to help the learners reach the next level (Vygotsky, 1987). The learners can reach the next level through; modeling where the more knowledgeable other demonstrates the pattern and explains the reasoning, guided practice by providing support and feedback as learners work on pattern-related task and independent practice by gradually releasing responsibility to learners as they become more confident.

Scaffolding is a concept in constructivist theory which refers to the temporary support and guidance provided by a more knowledgeable other to help learners achieve a specific learning goal (Wood et al., 1976). This support is gradually removed as learners become more confident and independent in their understanding. In the context of teaching Number Patterns, scaffolding is through modeling, guided practice, and independent practice (Vygotsky, 1987). Scaffolding increases confidence and independence in learners during the learning process (Hogan & Pressley, 1997).

Collaborative learning is a key concept in social constructivist theory. It refers to the process of learners working together to construct knowledge and meaning through interaction and dialogue (Vygotsky, 1978). This approach emphasizes that knowledge is socially constructed and learning is a process of negotiating and sharing meanings. Learners participate in class discussions to share their findings and solve problems related to Number Patterns (Hogan & Pressley, 1997). The application of collaborative learning within the classroom enhances creativity and critical thinking abilities, stimulates active learning and engagement, cultivates problem-solving and communication skills, and nurtures a sense of community and mutual understanding (Bruner, 1990).

Mediation is one of the key concepts in social constructivist theory. It refers to the process of using tools, symbols, or language to facilitate learning and understanding (Vygotsky, 1978). Mediation assists learners connect new information to their already existing knowledge and understanding. In teaching Number Patterns, mediation plays a role in using manipulatives like blocks or tiles to represent patterns, in creating diagrams or charts to visualize patterns, in using number lines to explore patterns, and engaging in discussions and using language to describe and explain patterns (Vygotsky, 1987). Mediation helps learners to develop abstract thinking and problem-solving, establish links between tangible and conceptual representations, facilitating the construction of meaning and comprehension through active social interaction.

The concepts of social constructivist theorem pertaining to the study on Number Patterns includes shared understanding where learners and teachers collaboratively develop a shared understanding of Number Patterns in the classroom, social negotiation between the teacher and learners to agree on a rule governing Number Patterns through social interaction, constructing meaning and understanding of number patterns through exploration and discussion between the teacher and the learners (Hogan & Pressley, 1997), generalisation and abstraction of Number Patterns from a specific instances to a more broader mathematical concepts, develop problem-solving skills by exploring, conjecturing, and generalising Number Patterns, communication and representation of their understanding of Number Patterns through various forms such as verbal, visual, and symbolic representation.

McKinley (2015) notes that contextual dependence; relational nature, cultural influence, and language and symbolism are significant concepts within the social constructivist theory. The contextual dependence refers to the way learners grasp mathematical concepts influenced by the context in which they are presented, alongside the teacher's capacity to foster an appropriate environment in the classroom conducive to knowledge advancement. In terms of language and symbolism, learners cultivate mathematical language and symbols to articulate and depict Number Patterns throughout the lesson (McKinley, 2015).

The social constructivist theory further claims that language and culture are the frameworks through which humans experience, communicate, and understand reality (Vygotsky, 1978). This

is to say that learning concepts are transmitted by means of language and comprehended through experiences and interactions within a cultural framework. This cultural framework pertains to the social and cultural context in which learning occurs (Vygotsky, 1978). This includes the values, beliefs, norms, and practices that shape the way individuals think, learn, and understand the world around them. Understanding the social and cultural context in social constructivist theory is crucial because constructivist theory acknowledges that learning is not a neutral or isolated process, but rather one that is deeply rooted in the social and cultural context. The social constructivist sees knowledge as what learners do in collaboration with other learners, teachers, and peers. This approach helps learners to collaborate with their teachers and classmates to build knowledge and comprehension by establishing a basis for cognitive development (Aljohani, 2017).

3.2.2. General application of social constructivist theory on teaching

The social constructivist theory has played a vital part in various aspects of teaching, from primary, secondary, and tertiary level in the development of knowledge in both formal and informal teaching and learning. The theory emphasizes that knowledge is constructed through social interaction and collaborative learning (Vygotsky, 1978). This approach has far-reaching implications for teaching practices, and for encouraging teachers to facilitate learner-centred learning environments that foster active participation in the classroom situation (Dewey, 1938).

In education, a theory helps in understanding how knowledge is constructed through social interactions and cultural norms and informs teaching methods and curriculum design. In psychology and sociology, the theory examines individual perceptions, beliefs, social influence, cultural context, and how social structures, institutions, and relationships shape the understanding of learners within the teaching and learning environment (Gay, 2000). By acknowledging the different experiences and perspectives of learners thinking in the classroom, teachers can harness the power of diverse background to enrich the learning process (Gay, 2000).

Social constructivist theory highlights the role of language and discourses in shaping knowledge. Teachers ought to motivate learners to participate in discussions, pose inquiries, and clarify meanings to build their understanding (Vygotsky, 1987). Recent research has underscored the significance of linguistic diversity and inclusive language practices within the classroom (Gay, 2018). The social constructivist theory recognises the teacher-learner relationship as essential for

facilitating learning. Teachers should create a nurturing and inclusive learning atmosphere, offering scaffolding and feedback to learners as they develop knowledge (Vygotsky, 1978).

Moreover, social constructivism emphasises the role of context and culture in influencing teaching and learning outcomes (Bruner, 1990). Teachers should acknowledge and consider these factors when designing curriculum and assessments, ensuring that they are relevant and inclusive.

3.3 IMPLICATION OF SOCIAL CONSTRUCTIVISM ON TEACHERS' EXPERIENCES OF TEACHING

Since the study is focused on the experiences of mathematics teachers and their classroom practices, the role of the teacher is to mediate learning and scaffold learners through their experiences gain over the years (Shah, 2009). Social constructivism has significant implications for teachers' experiences of teaching, as it highlights the importance of social interactions, cultural contexts, and power dynamics in shaping teaching practices. Various research efforts have employed social constructivist theory to investigate the experiences of teachers, concentrating on three primary aspects: teacher identity, the relationship between teachers and learners, and the professional development of teachers.

Social constructivist theory has been used to explore how teachers construct their professional identities. Research has shown that teachers' identities are shaped by their social interactions with colleagues, learners, and the broader school community (Beijaard et al., 2004). A study by Sorensen (2004) found that teachers' identities were influenced by their experiences of being part of a particular school culture. Social constructivist theory has been used to examine teacher-learner relationships, with studies highlighting the importance of building positive relationships between teachers and learners, which are very critical for learners learning (Noddings, 2006). According to a study conducted by Valenzuela (1999), teachers who built strong relationships with their learners created a positive learning environment.

Social constructivist theory has been used to investigate teacher professional development. Research has shown that teachers' learning is shaped by their social interactions with colleagues and the broader educational community (Hargreaves, 2003). A study by Wegner (1998) found that teachers' participation in professional communities of practice was critical for their ongoing learning.

The use of social constructivist theory demonstrates an understanding of how teachers' instructional practices and interaction with learners influence learning outcomes. The experiences of mathematics teachers are gathered from their many years of practice, gained through the interactions with learners, colleagues, their own learning, and their social environment within which they perform their professional duties. The social constructivist theory allows for the interaction between teachers and learners in the classroom setting. This interaction fosters an environment conducive to learning. The growth of knowledge for each individual learner is improved through social engagement with the teacher (Shah, 2009). The thoughts, convictions, and premises held by the participants in their school environments after their experiences and play a role in the influence they exert on the learners, particularly in knowledge development (Shah, 2009).

The structure of this current study gave the researcher the opportunity to observe, explore, interact with, and understand the different teachers, their experiences and roles within the classroom environment. The social constructivist theory posits that individuals create their own ideologies, values, attitudes, and culture within a framework that improve their capacity to engage with their surroundings. Knowledge is acquired through the interaction between teachers and learners in the classroom (Mertens, 2009; Lincoln et al., 2011). Consequently, employing social constructivist theory in this research adds greater significance and understanding to the study.

3.4 IMPLICATIONS OF SOCIAL CONSTRUCTIVISM ON LESSON DELIVERY IN THE CLASSROOM

Social constructivism, often referred to as collaborative learning, emphasises interaction, discussion, and the exchange of ideas among learners within the classroom. This teaching approach facilitates various group configurations and interactive techniques within the classroom. These may encompass class discussions, the establishment of smaller peer group discussion, or collaborative work in pairs during specific activities throughout lesson. The teaching methods employed in the lesson or classroom can significantly influence the theoretical framework, as well as the essential art and science that inform the management and strategies utilised for effective lesson delivery. Dorgu (2015) characterises teaching methods as the strategies through which a teacher conveys the subject matter or mathematical content to learners, guided by predetermined

teaching objectives aimed at enhancing learners' learning. In accordance with Westwood (2008), teaching methods consist of principles that promote learning within the classroom.

The social constructivist theory claims that knowledge develops because of social interaction and not as an individual possession. Teaching methods and strategies such as case study, research projects, problem-based learning, brainstorming, collaborative learning, group work, and guided discovery learning can be used by teachers in the mathematics classroom (Kelly, 2012). In a social constructivist classroom, the teacher plays a crucial role as a facilitator, mediator, and co-learner (Vygotsky, 1978). The primary duty of teachers is to establish a learning environment that fosters active engagement, collaboration, and critical thinking (Lave & Wenger, 1991). Additionally, the teacher's role encompasses facilitating discussions and activities that enhance critical thinking and problem-solving skills (Hogan & Pressley, 1997). Teachers serve as mediators to guide learners' learning and offer scaffolding as necessary throughout the teaching and learning process (Vygotsky, 1987). Moreover, teachers motivate learners to take responsibility for their own learning and connect their experiences to real-life situations beyond the classroom (Ladson-Billings, 1995), foster a sense of community and promote collaborative learning (Wenger, 1998), and continuously assess and adapt strategies and approaches to meet the diverse needs of learners (Gay, 2018).

The use of the social constructivist framework in this study afforded the researcher the opportunity to observe, explore, and understand the different collaborative teaching methods and pedagogical experiences that allow the teacher to implement methods such as problem-based learning, brainstorming, group work, guided discovery learning, and a learner-centred approach in the teaching of Number Patterns. Teachers and facilitators of mathematics need to understand different domains of learners' learning to inform their teaching methodological knowledge. The social constructivist approach is more focused on innovative activities and knowledge acquisition. Constructivist theory emerges as a response to educational methodologies and classroom practices, including behaviorism and programmed guidance, and it provides a framework for exploring the influence of teachers' experiences within the classroom context while teaching Number Patterns (Saeheaw et al., 2013).

This research utilised the teaching of Number Patterns to explore teachers' experiences and methodologies in the classroom environment. Teachers implement activity-based lessons and problem-solving techniques, which align with the constructivist perspective on teaching and learning of mathematics (Hlamos, 1980).

3.5 THE ROLE OF THE TEACHER IN A SOCIAL CONSTRUCTIVIST CLASSROOM

The role of the teacher in the social constructivist classroom is to help learners develop their knowledge and to be a mediator or facilitator during the learning process in the classroom. The constructivist teacher allows learner responses to drive lessons, shift teaching strategy, and alter the content. Ndon (2011) asserts that within a social constructivist classroom, the teacher, acting as a facilitator, ought to create enriching environments, experiences, and activities for learning by incorporating opportunities for collaborative work, problem-solving, and authentic tasks to develop new knowledge.

The idea of problem solving in mathematics forms part of the constructivist notion of learning mathematics (Halmos, 1980). Teachers ought to choose activity-based approaches in the lessons they deliver to students to foster collaboration and teamwork. This enables learners to expand their knowledge through interaction with their peers in small groups. Mathematical modeling knowledge introduces learners to ideas within the integration of various concepts in mathematics. Critical realists recognise contextualised knowledge within a mathematical structure (Alderson, 2020). In the teaching of Number Patterns, teachers support learners in generalising concepts and fostering higher-order thinking through their teaching methods. Conceptual understanding of patterns and early algebra, multiplicative reasoning, and special structures also form the basis of the study through the experiences of teachers in teaching Number Patterns.

3.6 SIGNIFICANCE OF SOCIAL CONSTRUCTIVIST THEORY TO THE TEACHING OF NUMBER PATTERNS

The social constructivist theory has been widely used in various research studies. In this study on teachers' experiences of teaching Number Patterns, the researcher employed this theoretical framework to explore the teaching methods of teachers and to analyse how learners develop their comprehension of mathematical concepts through social interactions with their teachers and collaborative learning (Lerman, 1996). The framework aimed to explore how teachers assist

learners to recognise and extend Number Patterns, through discussions in the classroom and teacher guidance (Muller & Perlmutter, 2014).

The researcher employed a qualitative approach, conducting interviews and observing group work sessions to generate data (Cohen et al., 2018). The social constructivist theory was clearly demonstrated in the study's focus on how teachers' teaching techniques influence learners' comprehension of Number Patterns (Vygotsky, 1978). As the learners engaged in group discussions, they constructed their own knowledge by sharing ideas, listening to peers, and building on each other's thoughts (Brown et al., 1989). The research also recognised the importance of culture and context in influencing learners' learning experiences (Bruner, 1990).

The social constructivist theory emphasizes the importance of hands-on learning and the building of knowledge from personal experiences (Ndoh, 2011). This approach can be effectively used in teaching Number Patterns, as it allows learners to actively explore the concept of Number Patterns and construct their understanding. The framework allows the teacher to use manipulatives such as blocks, counters, and number rods to develop a concrete understanding of Number Patterns (Kelly, 2012). The teacher provides an opportunity for the learners to explore Number Patterns by encouraging the learners to create their own patterns using different materials and shapes, helping learners identify patterns of nature, music, and art.

The theory supports a learner-centred approach which encourages learners to fully participate in the lesson, thereby constructing their own knowledge and understanding of Number Patterns through exploration, discussion, and collaborative learning. The use of contextual learning, where learners use real-life examples and scenarios to illustrate Number Patterns, making numbers in the patterns more relatable and meaningful during the lesson (Ndoh, 2011). The teacher plays the role of a facilitator during the lesson, acts as a guide, supporting and scaffolding learners as needed. The teacher also fosters mathematical communication by assisting learners to articulate their thinking, listen to peers, and develop mathematical language and notation in the classroom (Vygotsky, 1978).

The theory establishes a foundation for teachers to engage in collaborative and enquiry-based approaches to assist learners to work together in groups, solve mathematical problems, share their

understanding, foster social interaction, and learn from each other's experiences and the experiences of the teacher (Alderson, 2020). Through the experiences of teachers, learners are presented with problem scenarios and invited to investigate various methods for resolving the issues. This approach helps learners develop problem-solving skills and foster critical thinking. The teacher motivates learners to establish connections between Number patterns and real-life contexts.

3.7 CONCLUSION

The application of the constructivist framework in the research highlighted the teacher's role within the classroom environment, situating the study within the realm of teaching. The social constructivist theory views learning as a social process in which learners collaborate through group activities to facilitate meaningful learning. Teachers employ teaching guidance by using teaching methods and strategies that allow knowledge discovery and construction as they engage with teachers and collaborate with fellow learners during the educational process. Social constructivism reallocates the responsibility of knowledge acquisition from the teacher to the learner and transforms the learner from a passive listener to an active participant and a co-constructor of knowledge in the learning process. Constructivist theory provides a valuable framework for effectively teaching Number Patterns by actively engaging learners in the learning process and assisting learners in developing a deep understanding of mathematical concepts and strong problem-solving skills. By applying the social constructivist theory, one can create a dynamic and interactive learning environment where learners actively construct their understanding of Number Patterns, cultivating a profound and more significant understanding of mathematics.

CHAPTER FOUR

RESEARCH DESIGN AND METHODOLOGY

4.1 INTRODUCTION

In the preceding chapter, the theoretical framework was examined, serving as the cornerstone of the study. The theoretical framework is crucial as it offers the structure, framework, and methodology for exploring teachers' experiences within their classroom practices. This chapter discusses the methodology of the study and the data generation method that was used in the research, as established by the objectives of the study. Research components such as paradigm, methodology, sampling and selection of participants, data generation, trustworthiness, and ethical issues were employed to address the objectives of the study. According to Yin (1993), the important aspect of a case study data generation is the use of multiple sources. Handling and synthesizing various forms of data at the same time provides diverse evidence needed for drawing conclusions from the research (Yin, 2017). Given that my research employed an interpretive design, the application of various data generation methods enabled me to tailor the data generation tools to the phenomenon being examined.

Thomas (1962), supported by Gibson (2016), defines paradigm as the different ways of understanding the world through various viewpoints on how it works. Poni (2014) asserts that a research paradigm encompasses ideas regarding ontology, epistemology, and methodology. According to Rolfe (2006), a paradigm comprises three elements: belief about the nature of knowledge, methodology, and criteria for validity. Nevertheless, paradigms play a crucial role in a research study, serving as the foundation for both the strategy and the way the interpretation of reality is developed and executed. The paradigm employed in this study is the interpretive research paradigm. In this study on teachers' experiences of teaching Number Patterns to grade 7 learners in KwaZulu-Natal, this chapter discusses the use made of this paradigm.

4.2 QUALITATIVE RESEARCH APPROACH

Qualitative research is a methodology aimed at comprehending and interpreting intricate phenomena, experiences, and in-depth meanings to a particular phenomenon (Creswell & Poth, 2018). It involves collecting and analysing non-numerical data, such as text, images, and observations, to gain insights into people's perspectives, behaviours, and experiences. Patton (2015) notes that the qualitative approach explores selected issues and generates detailed

information within the context of the topic. The qualitative approach aims to gain a rich and detailed understanding of the research topic (Miles & Huberman, 1994). The data was generated at the convenience of each participant, allowing for flexibility in accommodating the contextual factors of the participant. According to Patton (2002), qualitative research approaches are often flexible and adaptable to the participants, and this study considered the differences among the participants with different contextual factors.

The qualitative approach studies phenomena in their natural settings, and this study followed the same approach, where participants were interviewed within their natural settings. The qualitative approach allows for subjective views from participants. This present study sought to generate data that reflected multiple and subjective views of participants, as they have different backgrounds and experiences. According to Morse (2002), the individual teachers' reasoning, implications, and thinking become a critical aspect of qualitative data generation.

4.3 INTERPRETIVIST RESEARCH PARADIGM

The interpretivist research paradigm emphasises understanding and interpreting the meanings and experiences of individuals within a particular context (Scotland, 2012). It recognises that reality is subjective and shaped by individuals seeking to gain an in-depth understanding of their perspective and experiences. This study sought to understand the teachers' experiences of teaching Number Patterns within the environment of their schools, considering the social, cultural, and historical elements that influence the experiences of the participants.

The interpretivist research paradigm is suitable for this qualitative study on teachers' experiences of teaching Number Patterns, as it allows the engagement of the researcher with participants as they express their point of view on their classroom practices (Scotland, 2012). This study provided an opportunity to explore the classroom experiences of teachers regarding Number Patterns by engaging the participants in a face-to-face semi-structured interview. The data collected from the lived experiences of Grade 7 mathematics teachers aimed to comprehend how the participants interpret their experiences and the significance they attribute to those experiences within their classroom.

The application of the interpretivist paradigm, in conjunction with an exploratory case study, provided the researcher with the opportunity to understand the experiences of teachers in the context of teaching Number Patterns. The intention of the researcher was to explore teachers' experiences of teaching Number Patterns as part of the Grade 7 mathematics curriculum. In this study, the objectives of the study were met using the interpretivist paradigm. This allowed interaction with participants, which contributed to the generation of first-hand information via interviews. The interpretation of the findings was grounded in the teachers' experiences with teaching Number Patterns, concentrating on classroom practices. The participants' responses were not swayed by the researcher; therefore, the data reflect the genuine responses and representations of the participants.

4.4 EXPLORATORY CASE STUDY DESIGN

Different scholars have defined case study in various ways: A case study, according to Yin (2018), is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clear. A case study is both a process of inquiry and a product of that inquiry (Stake, 1995). Merriam (2009) states that a case study is an intensive, holistic description and analysis of a single entity, phenomenon, or social unit. The types of case study employed by researchers include exploratory case study, descriptive case study, explanatory case study, intrinsic case study, and instrumental case study. According to Yin (2009) descriptive case study provides a detailed description of a phenomenon within its context. An explanatory case study seeks to establish a cause-and-effect relationship (Yin, 2009). An intrinsic case study examines a unique or unusual situation that offers valuable insights (Stake, 1995). The focus is on understanding the case itself, rather than generalising to other cases (Coombs, 2022). An instrumental case study uses a specific case to understand a broader issue (Stake, 1995). It provides insights into a larger phenomenon or concept (Coombs, 2022).

An exploratory case study is used to explore a phenomenon or issue, or often to identify patterns or relationships (Yin, 2018). Teaching is a complex phenomenon, and an exploratory case study can help uncover the nuances and intricacies of teachers' experiences (Merriam, 2009). According to Yin (2018), an exploratory case study can help identify patterns and themes in teachers'

experiences, which can inform future research and practices. This study employed an exploratory case study design due to the limited existing research on teachers' experiences of teaching Number Patterns, as supported by Creswell (2013).

An exploratory case study design is particularly useful in qualitative research on teachers' experiences of teaching Number Patterns. This methodology facilitates a thorough analysis of a particular case or phenomenon, offering comprehensive and nuanced insight into the experiences of teachers. The study employed this design to enable the researcher to explore, examine, and gain a detailed understanding of how teachers' experiences influence the teaching of Number Patterns in Grade 7.

The research considered the social, cultural, and historical contexts in which teachers teach Number Patterns, offering a detailed insight into the experiences of teachers. In line with a qualitative research approach, the exploratory case study acknowledges the role of subjectivity in shaping the research process and outcomes, enabling the researcher to explore the teachers' experiences from their own perspective, and this study allowed the participants to express themselves within the contexts of their classroom practices. According to Yin (2003), an exploratory case study permits the application of various data generation techniques. Consequently, this study employed semi-structured interviews and classroom observations to explore the diverse classroom experiences of the teacher-participants.

4.5 SAMPLING

Sampling in qualitative research is the process of selecting participants or cases that can provide rich, in-depth insights into the phenomenon being studied (Creswell, 2013). Unlike quantitative research, which aims for representativeness and generalisation, qualitative research seeks to understand the experiences, perspectives, and meanings of a particular group or phenomenon (Merriam, 2009). The various forms of sampling used by researchers include purposive sampling, convenience sampling, snowball sampling, and theoretical sampling. Purposive sampling is a non-probability sampling method utilised in qualitative research to select participants who are rich in information and can provide in-depth insights into the research phenomenon (Patton, 2002). Snowball sampling is a non-probability sampling technique where existing participants recruit other participants from their social networks (Naderifar et al., 2017). Theoretical sampling is a

method used in grounded theory research, where data collection and analysis occur simultaneously, and participants are selected based on emerging theories (Glaser & Strauss, 1967). It is the process of selecting cases to elaborate and validate theoretically derived variations discerned in the data (Patton, 1990). Convenience sampling is a non-probability sampling method where participants are selected based on their availability and willingness to participate (Patton, 2002).

According to Patton (2002), purposive sampling is selecting participants based on their expertise, experience, or relevance to the research question. The researcher employed purposive sampling to identify and select participants for the purpose of generating data pertinent to the research study. The individuals involved in the study were mathematics teachers with professional qualifications, each possessing over five years of teaching experience and expressing a willingness to take part in the research.

The individuals were chosen because they were relevant to the research questions, thereby guaranteeing that the data generated is pertinent and beneficial. It was important to select experienced mathematics teachers who not only wanted to participate but also wanted to share their lived experiences in primary school teaching. In this study, the researcher aims to choose participants capable of offering comprehensive insights regarding the research subject to achieve the research objectives. By selecting participants who are knowledgeable in the topic, the participants become relevant to the research questions, and high-quality data are generated. Purposive sampling allows the researcher to exert some influence over the chosen participants who can respond to the inquiries, thereby generating substantial data for the study (Acharya et al., 2013; Oppong, 2013).

According to Silverman (2015), using purposive sampling can generate high-quality, relevant data that provides insight into the topic of the research study. Establishing the research study's objectives at the outset of data generation helped the researcher concentrate on the sampling methods for the study (Israel, 2014). The difficulty associated with purposive sampling lies in identifying participants who fulfill the research criteria, and the biases and subjectivity of the researcher may affect the selection process, which could result in a biased sample.

Table 4.1 Grade 7 teacher participants' profile

Teacher	Gender	Number of years of teaching Mathematics	Age
Seed	Male	6 years	31
Delta	Male	10 years	42
River	Female	8 years	34
Ocean	Female	14 years	49

4.6 DATA GENERATION METHODS

The research utilised two methods for data generation. These instruments included semi-structured interviews and classroom lesson observations. The intention behind employing multiple data generation methods was to capture the experiences and perspectives of different participants. The different methods provide comprehensive data for analysis, thereby allowing for an examination of the case from various perspectives and the diverse evidence necessary for drawing conclusions (Yin, 2017). Semi-structured interviews and observations were utilised to generate data regarding the skills, attitudes, beliefs, knowledge, choices, and methods employed in teaching mathematics to seventh-grade learners. According to Cohen et al. (2007), the use of varied data generation instruments improved the study's validity.

The semi-structured interview facilitated the researcher in gathering information and verifying the data generated during observations, in the form of the preferences and attitudes of the teacher towards the teaching of mathematics. All participants were treated with dignity during data generation to provide vital information for the study. The teachers' experiences of teaching mathematics to Grade 7 learners from the semi-structured interviews and observations provided critical feedback on teachers' experiences of teaching the Grade 7 mathematics curriculum in KwaZulu-Natal.

4.6.1 Semi-structured interview

A semi-structured interview is a qualitative research method that combines the benefits of structured and unstructured interviews. It involves asking a set of predetermined, open-ended questions while allowing for flexibility in the conversation flow. This method enables researchers to generate rich, detailed insights into participants' thoughts, feelings, and experiences (Creswell, 2013). This study utilised semi-structured interviews which provided a balance between structured and flexibility, maintaining a level of consistency across interviews during the study.

The interviews were conducted in a conducive environment for participants to encourage openness and trust. It was a flexible data generation tool that conducted a face-to-face conversation focusing on the past or present situation of their experiences within the context of teaching Number Patterns. The researcher, together with the participants, explored issues in depth, explaining the different frames of ideas, exploring the connections between participants' values, opinions, events, and behaviours to their experiences of teaching mathematics.

Throughout the comprehensive semi-structured interview, the researcher meticulously observed participants' non-verbal communication while upholding professionalism in accordance with the ethical standards of the research study. The researcher fostered an environment of honesty and freedom of expression by building rapport with participants and allowing the participants to share their thoughts and experiences in detail, yet prioritising the clarity of the participants' responses. Acquiring information regarding the emotional dimensions of participants' classroom practices during the interview was approached with care and a non-judgmental attitude. Effective communication was established and maintained throughout the interview, using open-ended questions which made it easier for the researcher to find more details.

The face-to-face interview was recorded for the purpose of an accurate transcription of data during the study (Wilcox & Keselman, 2012). The researcher and participants agreed on two interviews; each interview took approximately thirty-five minutes. The second interview was to validate the initial findings, ensure accuracy, and to get feedback from participants on the researcher's interpretations. To follow up on initial findings, clarify any ambiguities, and to generate more in-depth information to further explore specific themes that emerged during the initial interview,

allowing for a more nuanced understanding. The second interviews were conducted two weeks after the initial interviews due to the availability of the participants.

4.6.2 Classroom Observation

The use of observations by the researcher as a data generation method was meant to observe the events, teaching methods, teacher and learners' behaviour, and the setting within which the mathematics lesson was delivered. The observations were made in the classroom during a lesson on Number Patterns, every necessary arrangement was made before the lesson observation commenced. The observations were scheduled on a different day from the face-to-face interview. The reality of teachers' experiences of teaching Number Patterns was observed by the researcher, giving a different perspective.

To enhance the process of data generation during classroom observations, the researcher employed an observational protocol. This protocol encompassed the following components: subject matter content, organisation of the subject matter, rapport of the lesson, teaching methods, presentation of the lesson, classroom management, sensitivity to diversity, support for learners during the lesson, personal conduct, and physical aspects of the classroom. As noted by Wellington (2005), observation provides the researcher with direct information derived from a naturally occurring social context, rather than relying on reported data.

Throughout the observations, the researcher documented the interactions between the teacher and the learners, their reactions to the learners' inquiries, their facial expressions while teaching, and their teaching methods in the classroom. The purpose of utilising observations in this study was to address the questions of how teachers' experiences influence the teaching of Number Patterns. These observations provided the research with direct insight into the non-verbal behaviours of the participants in their natural environments.

4.6.3 Follow-up contacts

The researcher and participants agreed on a possible follow-up contact for further clarification on the data generated. The reasons for the follow-up contact were to acquire more insight from participants' information on exploring the experiences of teaching Number Patterns to Grade 7 learners. The follow-up contact was done telephonically at the convenience of the participants'

time, maintaining professionalism and dignity of both the researcher and the participant (Seidman, 2013). The follow-up was meant to discuss the areas in the interview where the researcher needed the opinion of the participants, and to make further enquiries on some of the observed behaviour of the participants during the observation and how it contributed to the teaching of Number Patterns. The follow-up discussions were strictly based on the study, and no personal issues were discussed. In some instances, the participants added additional information, which was not given during the face-to-face interview, which contributed richly to the data generated.

4.6.4 Field notes

The researcher took field notes during the face-to-face interviews and during the classroom observations. A mini field note booklet was used to jot down the observed attitude and behaviour of the participants, which happened consciously or unconsciously during the interview and classroom observation. During the interviews, verbal communication and bodily gestures were used, which revealed the emotions behind the experiences of the participants in their classroom practices. The observation conducted in the classroom unveiled experiences of the participants that were not clearly articulated during the semi-structured interviews. The positive demeanor and enthusiasm displayed by participants, as noted by the researcher, added greater depth and understanding to the data generated. As stated by Spradley (2016), field notes enhance the significance of both the participants' statements and the researcher's observations. The observable experiences included the ways in which participants recognised learners' efforts, the effectiveness of the classroom management, and the methods employed in providing feedback to learners within the classroom.

4.7 DATA ANALYSIS

The analysis and interpretation of data necessitate that the researcher possesses the ability to organise, describe, comprehend, account for, and elucidate data, particularly in relation to the definitions provided by the participants regarding the situation. This involves identifying patterns, themes, categories, and regularities (Braun & Clarke, 2006; King, 2004). As stated by Cohen et al. (2007), effective data analysis and interpretation demand that the researcher engage in critical reading and acknowledge the connections between the statements made by participants to derive meaning from the data.

The semi-structured interview, classroom observation, follow-up communications, and field notes are well-suited to the interpretive paradigm and qualitative research methodology, as well as the data analysis (Taylor & Gibbs, 2010). The information obtained from the in-person semi-structured interviews was transcribed, analysed, and interpreted in conjunction with the observational data, which was subsequently compiled into a narrative report. The researcher converted the data generated into themes. According to Braun and Clarke (2006), the use of thematic analysis allows the researcher to examine the perspectives of the different participants, highlighting similarities and differences, and generating unanticipated insights. The researcher used the following thematic analysis steps to analyse and interpret the data to construct a comprehensive report on the teachers' experiences of teaching Number Patterns to Grade 7 learners (Braun, Clarke & Terry, 2014). The steps below were taken from (Braun et al., 2014).

Step 1: Researcher getting familiar with the data generated

Becoming familiar with the data generated is a very important process requiring the researcher to listen extensively to the recorded interviews and critically read over the observation notes. As stated by Silverman (2016), extensive listening of the recorded interview, getting familiar with the responses of the participants, and transforming it into meaningful data requires the ability to listen attentively and critically, comprehending the meaning attached to each participant's responses. Transcribing the data becomes easier when the researcher actively engages with the data generated (Braun et al., 2014). To analyse and classify data is to narrate the story connecting to the research questions (Braun & Clarke, 2014).

Step 2: Data coding process

The data was continuously analysed to eliminate the responses that did not correspond to the questions. The researcher recognised data that were interconnected in meaning and categorised them under the same code.

Step 3: Creation of themes

The responses from participants were categorised into significant themes based on a classification of codes developed from the similarities observed in their responses.

Step 4: Re-evaluation

The researcher conducted a re-evaluation of the themes to guarantee that the experiences of teachers are accurately reflected in the teaching of Number Patterns to Grade 7 learners. During the re-evaluation process, the researcher meticulously records notes regarding the themes and the concepts articulated within the study's context and reviews the data prior to sharing it with the participants.

Step 5: Report

The last step was the presentation of the findings gathered from exploring teachers' experiences of teaching Grade 7 mathematics in KwaZulu-Natal. Inductive reasoning was employed during the analysis of the findings. Gibbs (2018) alludes that inductive analysis is derived from similar data given by different participants based on their contextual factors in the execution of their duties. During the data analysis, themes were created as per the data generated from the participants' responses. The results of teachers' experiences in teaching Grade 7 learners on Number Patterns in KwaZulu-Natal were analysed in relation to the current literature to deepen the comprehension of the data obtained from the participants.

4.8 ISSUES OF TRUSTWORTHINESS

The ability of the researcher to conduct a credible study is dependent on the study procedures' trustworthiness (Korstjens & Moser, 2018). The researcher fully employed the norms and standards of conducting a qualitative research study in generating data. The implementation of in-person semi-structured interviews and observations aimed to foster an extended interaction with the participants during the data collection process. To sustain the trustworthiness of the study, the researcher employed a more comprehensive explanation derived from the data produced by the experiences of four Grade 7 mathematics teachers, thereby offering a clearer interpretation of the verbal expressions and observational notes.

The participants provided an honest account of their practices, and the researcher mitigated any potential for unfounded claims and bias by employing follow-up questions that directed the participants towards the study's objective. The researcher employed identical questions for all teachers involved in the study, ensuring that no modifications were made to the questions. Confirmability was achieved through the uniformity in the questioning of the teachers throughout

the study. A professional relationship was upheld between the researcher and the participants to ensure that the data remained untainted by the dynamics of their relationship.

The researcher took field notes during the data generation period, during both interviews and classroom observations on participants' responses. The researcher continuously maintained the status of being a qualitative researcher, avoiding prejudging and making assumptions on the responses of the participants. The researcher collected the data generated by the participants without embellishing or swaying the responses to ensure the integrity of the study. The credibility of the research was established by the researcher recognising the varied experiences of the teachers' classroom practices while teaching Number Patterns to Grade 7 learners. The researcher illustrated the authentic representation of the phenomenon being examined, extending the interaction with participants, maintaining involvement, conducting debriefing, and performing member checking throughout the data collection

4.9 ETHICAL CONSIDERATION

Research ethics refers to the safeguarding of the participant's rights, honor, and dignity by the researcher during the study (Stevens, 2013). Ethics establishes the moral principles that direct the ethical conduct and interactions between the researcher and the participants (Wassenaar & Mamotte, 2012). According to Roberts (2015), acknowledging and sensitising participants by the researcher about the study ensures that participants understand the purpose and benefit of the study, and establishes a rapport with the participants. Application letters were composed to gatekeepers seeking authorisation to carry out the research study. Correspondence was dispatched to the following individuals: The Chief Executive Officer of the KwaZulu-Natal Department of Education (KZN DoE), school principals, and the participating teachers. The researcher obtained ethical clearance approval from the University of KwaZulu-Natal (UKZN). The researcher was granted permission to gather data from teacher participants in their respective schools.

To uphold a professional relationship between the researcher, the school principals, and teachers, a letter was composed to the principal and teacher participants detailing the purpose and objectives of the research study. Furthermore, a consent letter to participate was sent by the researcher to participants, which stated the confidentiality of the data that would be gathered from the participants. The participants provided the researcher with consent to carry out the study. The

confidentiality of the participants was upheld during the entire study, as participants were given pseudonyms, for example, Seed, River, Ocean, and Delta. The privacy of participants can be maintained by assigning pseudonyms (Creswell, 2013). Sufficient information was included in the consent letters addressed to teacher participants, empowering them with the authority to voluntarily choose whether to take part in the research study. According to Manadhar and Joshi (2020), consent letters to participants in research should contain all necessary information to assist participants in making a proper decision on their participation in the study.

The researcher negotiated with the principals and teachers during the delivery of the consent letters on the date and time for the data generation, thereby building a respectful relationship with the gatekeepers and participants. The voluntary participation and withdrawal of the participants at any stage of the study were further discussed (Kadam, 2017). Participants were guaranteed that the study was strictly academic in nature and that no harmful information would be disclosed to them. The participants voluntarily signed the consent form, permitting the researcher to record the interview. The ethical standards upheld during the study fostered genuine engagement among the participants, resulting in a successful research endeavour.

4.10 LIMITATIONS OF THE STUDY

The study was conducted at Ixopo in the rural midlands of KwaZulu-Natal, with a small number of participants. As a qualitative study, the aim was not to generalise to all teachers. Time management posed a challenge for the participants, as punctuality was not maintained due to various reasons and commitments. Although the findings of this study do not reflect the experiences of all Grade 7 mathematics teachers in KwaZulu-Natal and South Africa, they contain a strong representation of the challenges Grade 7 mathematics teachers face when teaching Number Patterns and their experiences with learners in the mathematics classroom.

4.11 DELIMITATION OF THE STUDY

The research was confined to Grade 7 mathematics teachers possessing more than five years of teaching experience. It concentrated on the teachers' experiences in teaching Number Patterns as part of the mathematics curriculum. As a qualitative study, data were generated from four mathematics teachers across four distinct public schools located in the Ubuhlebezwe local municipality of KwaZulu-Natal.

4.12 CONCLUSION

The chapter outlined the qualitative research design and methodology used in data generation. The participants in the study were purposively selected, and this was evident in their practice and attitudes throughout the study. The issue of trustworthiness, ethical consideration, analysis, follow-up contact, limitations of the study, and delimitations of the study were all discussed as important aspects of the study. The next chapter presents the findings, analysis, and interpretation of the data generated in the study on teachers' experiences of teaching Number Patterns to Grade 7 learners in KwaZulu-Natal.

CHAPTER FIVE

PRESENTATION OF FINDINGS AND DATA ANALYSIS

5.1 INTRODUCTION

The preceding chapter outlined the design and methodology employed in the study, emphasising the semi-structured interview and lesson observation as instruments for data generation. This chapter details the findings and analysis regarding teachers' experiences in teaching Grade 7 learners on Number Patterns in KwaZulu-Natal. The attached interview schedule and observation schedule (appendices E and F) indicate the structure and the focus of the data generation. The data generated from the semi-structured interviews was analysed under four main themes related to the experience of choosing and using the relevant teaching methods choosing and using the relevant teaching methods selecting the relevant strategies when teaching Number Patterns, using the relevant approaches in teaching Number Patterns, and developing critical thinking skills during the teaching and learning of Number Patterns. These primary themes are subsequently divided into sub-themes that emerged after reviewing and becoming acquainted with the data.

The direct quotes from the teacher participants are presented in italics and remain unaltered. Pseudonyms were employed to denote the teacher participants. The information produced by this study aimed to address the two principal questions:

- What are the teachers' experiences of teaching Number Patterns to Grade 7 learners in KwaZulu-Natal?
- In what ways do teachers' experiences influence their approaches to teaching Number Patterns in Grade 7?

The findings and discussions are based on the teachers' experiences of teaching Number Patterns to grade 7 learners. The table below illustrates the order in which the data were organised and presented in this study.

Table 5.1 Organisation and presentation of teachers' experiences

THEMES	SUB-THEMES
1. The experience of choosing and using the relevant teaching method	▪ Methods promoting learner participation. ▪ Explain mathematical concepts within Number Patterns.
2. The strategic experience of teaching Number Patterns	▪ Using concrete objects ▪ Use of guided observation to determine the common change in Number Pattern. ▪ Integrate mathematical concepts in teaching Number Patterns
3. The experience of using the relevant teaching approach in teaching Number Patterns	▪ Scaffolding through questioning ▪ Monitoring and shaping learners' responses ▪ Facilitating the learning process
4. The experience of developing critical thinking skills	▪ Communicating mathematical ideas and knowledge

5.2 WHAT ARE THE TEACHERS' EXPERIENCES OF TEACHING NUMBER PATTERNS TO GRADE SEVEN LEARNERS IN KWAZULU-NATAL?

This section of the data presentation presents the main findings that emerged in response to the first research question. The teachers' responses were based on their personal experiences, professional experiences, cultural experiences, and emotional experiences, and guided by their classroom practices, skills, knowledge, and competence acquired from their many years of teaching Number Patterns in Grade 7.

5.2.1 THEME 1:

THE EXPERIENCE OF CHOOSING AND USING THE RELEVANT TEACHING METHOD

Teaching learners Number Patterns during mathematics lessons is a multifaceted and demanding endeavor that necessitates a variety of approaches to accommodate the diverse needs of learners, ensuring effective teaching and learning can occur. Effective mathematics teachers employ various methods to foster understanding, critical thinking, and problem-solving skills. The data generated from the teacher participants showed the different methods adopted by the teachers during their lessons when teaching Number Patterns. These reflected their classroom practices exhibited in participants' verbatim responses. A teacher occasionally employs various techniques during a single lesson to accommodate differentiated teaching within the classroom. This theme is subdivided into two sub-themes: teaching methods that encourage learner active participation in a social learning classroom, and explanation of concepts within Number Patterns and other mathematics concepts in the teaching of Number Patterns.

Sub-Themes:

5.2.1.1 Methods promoting learner participation

Teaching methods that encourage active participation are crucial in today's social learning classroom. Teacher participants highlighted the importance of methods that promote active learner involvement through collaboration and discussion. The findings from the data generated show how teachers engaged learners during the lesson.

River: *Learners earned points for answering questions and sharing ideas in the class. I expect learners to cooperate with each other and share their opinions in the classroom. I normally use collaborative learning in the classroom where learners compare their findings on numeric and geometric patterns; allowing learners to develop from each other.*

Ocean: *I let learners lead in the class discussions and share their findings and responses with the class. During problem-solving in the classroom, learners participate fully by finding solutions to the given problem in the lesson. Learners cooperate with one another and find the mathematical rule for patterns.*

Delta: *I allow learners to come forward and elaborate on their answers and findings, allowing the learners to ask questions and respond to questions asked by their peers. Learners play a central*

part in class discussion through their groups in the class. Learners agree in their groups to present a collective finding on a given task on Number Patterns, unifying their ideas together and cooperating with each other and building a common idea to present in the class.

Seed: *I allow the learners to initiate the discussions in the class by first allowing the learners to state their challenges and opening for groups to make their input on the opinion of their peers on the topic of discussion in the class. I normally put learners into groups and allow the learners to share ideas and encourage the learners to collaborate with each other in the classroom developing their knowledge, strength and assisting each other.*

The participants' responses indicated that they used varied methodologies when teaching Number Patterns; for instance, Seed and Delta incorporated group work into their collaborative learning approach in the teaching of Number Patterns to allow the learners to work together, share vital information, and cooperate with each other to develop a common idea. Seemingly, River's use of cooperative learning was to improve learner retention and develop leadership qualities and teamwork skills that foster the transfer of knowledge among the learners. The experiences of the teachers from the data show that using social learning methodology places the responsibility of knowledge construction on the learners. The learners are allowed to discover themselves through social interaction and shared ideas within the classroom. Ocean explained further that the methodology of allowing learners to collaborate with each other and cooperate was adopted to allow learners to interact with each other to build and develop their own knowledge of Number Patterns.

The feedback indicates that teachers employed questioning strategies, concept mapping, and interactive chalkboard exercises crafted by the teachers to engage learners and encourage their full participation in the lesson. Ocean stated that getting learners to participate fully in a lesson was a huge task for teachers. However, she used problem-based learning to get the learners to participate in the lesson. Delta also concluded that to achieve active learner participation in Grade 7, teachers must be more innovative in integrating numerous activities such as self-assessment rubrics, reflective portfolios, incentives, recognition of learner effort, and interest-based learning. From the responses of the teacher participants, effective teaching and learning methods that foster social

learning in the classroom promote deeper understanding of concepts, critical thinking, and collaboration among the learners. Teachers used collaborative activities to encourage learners to work in groups, share ideas, and build understanding of their own strengths and weaknesses.

According to Delta and Seed, learners were allowed to work in smaller groups to achieve shared goals, promote teamwork in the class, develop good communication skills, and develop problem-solving skills. The use of social learning strategies by teachers indicated that they were well-trained and understood the learning needs of the learners in the classroom.

According to Webb (2009), collaborative learning, such as group work and peer-to-peer discussions, is effective in promoting social learning in the classroom. Collaborative learning improves learners' understanding, retention, and application of knowledge (Hmelo-Silver, 2004). The findings indicate that all teacher participants used collaborative methods through group work in teaching Number Patterns, allowing the learners to discover and learn from each other. In using collaboration to promote social learning within the classroom, teacher participants allowed learners to lead in the lesson and work together to find the relevant ideas to help the learners develop knowledge.

Based on the experiences of the teachers in teaching Number Patterns, conceptual understanding was facilitated by using collaborative learning occasioned by group work. As stated by Bandura (2018), individuals acquire knowledge most effectively by observing, imitating, and engaging with others. The data generated through the semi-structured interviews and the classroom observations reveals that teachers used methodologies that re-enforced learner cooperation and collaboration in class to develop their own knowledge (Vygotsky, 1978).

Learner active participation in class can also include contributing to the discussions, asking questions, and taking ownership of one's learning (Hativa, 2013). Many teachers become excited and passionate about their learners when they show willingness to be involved in a particular lesson, a form of motivation by the learners. In support of the discussion on learner active participation in class, Deci and Ryan (2000) state that when learners feel invested in the learning process, they become more enthusiastic and engaged. This motivation leads to an increase in learner autonomy, self-direction, self-sufficiency, and desire to learn (Bandura, 1997). In

encouraging learners' active participation, a teacher normally uses activities such as group work to identify and extend Number Patterns, promoting collaboration and communication (Knuth & Stephens, 2018).

Improving learners' engagement in the classroom results in learners' understanding of the materials used in the class to support teaching and learning. However, when learners are engaged in a lesson, it creates a high retention for learners and effective processing of information during learning (Bransford et al., 2000). Teachers understand the importance of learner active participation in group work, problem-solving, and class discussions in improving learners' comprehension and application of knowledge (Hmelo-Silver, 2004).

The use of questioning activity in Number Patterns, as reflected in the data, encourages learners to think critically. Teachers' use of digital tools in exploring patterns enhances learner engagement and understanding in the classroom, which allows learners to link their classroom knowledge to the real-world context, making learning relevant and engaging (Mason, 1998; Hativa, 2013; Van de Walle et al., 2018). Through critical thinking, learners can develop analytical skills through classroom discussions, debates, when justifying their responses in class, and problem-solving activities (Paul & Elder, 2006). These skills assist learners to evaluate and compare ideas and opinions, justify and make informed decisions, and solve complex problems.

Discussion initiated by learners in the classroom promotes interactions between teachers and learners, as well as collaborative learning. Learners working together, sharing ideas, and building on each other's strengths (Johnson & Johnson, 2009) promotes social learning, teamwork, and mutual respect. The teacher-learner interaction and feedback to learners, guidance in discussions, support, individual attention, and clarification from the teacher (Hativa, 2013) motivate learners' participation in the classroom.

5.2.1.2 Explain mathematical concepts within number patterns

This section of the data analysis discusses the role of teachers in explaining new concepts within Number Patterns during the lesson and the concepts integrated into the teaching of Number Patterns within mathematics. One aspect of effective classroom learning is how teachers simplify new and complex terminologies in the learning process. Effective explanation of concepts enables

learners to understand underlying principles in Number Patterns, envision mathematical connections between the various concepts, develop problem-solving skills, and activate learners' participation with understanding. The responses below confirm how teachers enhance mathematics understanding through explanation of concepts:

River: *I explain new concepts and where learners are failing to understand I relate different concepts to assist the learners build ideas.*

Ocean: *I will explain new concepts to learners and more remedial work on explanation on how to generate and extend patterns.*

Delta: *I use different methods to explain concepts in Number Patterns to struggling learners in the class. I use individual learner approach to give more remedial work on explanation of terminology to learners.*

Seed: *I explain the concepts that are confusing to the learners. My idea of explaining the concept is to bring to the attention that all starts off and continue with the same fixed design or quantity in Number Patterns. Before I start teaching and giving the learners activities, I explain all the terminologies and concepts that will be integrated into the lesson, like consecutive terms, multiples of numbers, prime factors, and composite numbers. This gives the learners an idea of what to expect in the lesson.*

From the data, Ocean explained new terminologies, gave explanations to certain procedural and routine steps, and explained concepts that were new to the learners. The teacher must explain procedural steps for learners to be able to solve problems in Number Patterns. Explanation in mathematics is an on-going process that benefits learners at any stage of the lesson. Seed always started by explaining concepts that are integrated in the lesson for clarity on the concept being discussed. In this research, teachers utilised visual, conceptual, and procedural explanations to help learners enhance their mathematical comprehension.

The use of verbal explanation in the mathematics classroom builds the learners' listening skills, develops language proficiency, and creates a platform for learners to frequently ask questions in

the lesson. The explanation of mathematical concepts helps clear misunderstanding and errors that learners might have developed in their previous class.

The teachers employed strategies for learners to retain the knowledge and understanding that was developed during the lesson. I identified a common trend among the teachers using different teaching methods to get concepts across to learners. The use of real-world illustrations was made by the teachers to motivate learners' understanding. Delta used two ways of reinforcing the understanding concepts in Number Patterns lessons through individual and group explanations. River and Seed created a comprehensive list of all the terminologies relevant to the lesson, which was elucidated at the outset of their teaching during the introductory phase or at the end of the lesson when the teacher concluded the lesson. The teachers kept repeating and asking individual learners to keep reminding the class of these terminologies. The idea of explaining new concepts requires the teacher to possess a strong content knowledge in mathematics to be versatile in concept explanation in mathematics. Effective explanation of concepts requires good pedagogical skills to merge concepts (Hativa, 2013). In mathematics lessons, teachers carry the burden of providing clear definitions to mathematical concepts (Mulligan & Mitchelmore, 2009).

According to Wiggins and McTighe (2005), learners' retention of information and ideas is increased when the explanation is clear and concise. This creates learners' interest and motivation (Webb, 2009) and allows learners to grow in confidence in their mathematical abilities and problem-solving skills (Knuth & Stephens, 2018). The teachers used simple language to explain the complex concepts in Number Patterns and provide the learners with concrete examples of their explanation (Mulligan & Mitchelmore, 2009).

In a social learning classroom, the focus of concept explanation must be geared towards the facilitation of mathematical knowledge construction (Vygotsky, 1978). Participants used explanation to encourage peer-to-peer discussions, shared understanding, and building on prior knowledge. Learners were allowed to explain concepts to their peers, thereby taking the responsibility for developing their understanding. Teachers encouraged diverse explanations from individual learners, valuing their solutions and connecting different ideas from their peers to make a meaningful body of mathematical knowledge. The learners' excessive and ambiguous

explanations were controlled by the teachers to avoid the lesson from deviating from its primary objectives. Based on the methods employed by teachers, the elucidation of mathematical concepts throughout the teaching and learning of Number Patterns is vital in the development of learners' understanding and knowledge. Effective explanation simplifies complex information, promotes connections within the broader scope of mathematics, and develops problem-solving skills in mathematics learning.

5.2.2 THEME 2

THE STRATEGIC EXPERIENCE OF TEACHING NUMBER PATTERNS

The data generated through the semi-structured interviews and classroom observation shows that teachers selected relevant strategies to facilitate learners' comprehension by promoting critical thinking and generalisation of Number Patterns. This theme is subdivided into three sub-themes: Use of concrete objects; use of guided observation to determine the common change in Number Patterns, and integration of other mathematical concepts in teaching Number Patterns. According to Mulligan and Mitchelmore (2009), teachers assist and guide learners to recognise relationships between numbers through strategies such as difference tables and ratio tables. Teachers introduce learners to algebra expressions to represent patterns, enabling learners to generalise and extend the sequence (Kieran, 2006).

To make the learning of Number Patterns relevant to learners in the class, teachers choose realistic strategies, such as utilising tiles to make generalisations more relevant. It is further stated by Van de Walle et al. (2018) that teachers' way of making patterns relevant is to connect numeric patterns real-world context to encourage learner engagement. The teachers used inductive reasoning to identify patterns and guide learners in generalising numeric and geometric patterns. According to Webb (2009), teachers facilitate group work and discussions to promote shared understanding in generalising patterns. It was impressive to see that the teachers provided the means for learners to generalise patterns through the extension of patterns. The teachers asked learners to extend patterns, explain, and justify their generalisation to demonstrate their understanding of underlying relationships in Number Patterns.

Sub-Themes

5.2.2.1 Use of concrete objects

This section of data presentation and analysis examines the application of concrete objects in the teaching and learning of Number Patterns. The teacher participants used different concrete objects, such as manipulatives, as teaching aids in numeric and geometric patterns, and charts as teaching and learning materials, where worksheets were created to help learners grasp the concept of Number Patterns. Concrete objects play a significant role in the teaching of numeric and geometric patterns. In the primary school level, tangible materials introduce the learning of patterns from abstract to a more realistic way of perceiving Number Patterns in the context of the classroom. The use of these concrete objects helps learners visualise, explore, and comprehend more complex mathematical concepts. Concrete objects such as blocks, counting bars, and number tiles assist learners to identify, recognise, and extend numeric patterns (Mulligan & Mitchelmore, 2009; Knuth & Stephens, 2018; Van de Walle et al., 2018). In geometric patterns, concrete objects such as, pattern blocks, tangram puzzles, and geoboards facilitate exploration and understanding of geometric patterns (Sinclair & Cespo, 2017; Hativa, 2013; Gutierrez & Jaime, 2015). The data below shows responses of the teacher participants during the semi-structured interviews:

River: *I introduce concrete objects when linking numeric patterns with geometric patterns in the lesson. I use match sticks for learners to construct simple block patterns of shapes and deriving the algebraic equation from the constructed shapes. I ask learners to observe the shapes we created with the match sticks and then identify the common change in the shape to formulate the rule. I design charts with various patterns to allow learners to see the various forms of patterns and be able to compare and differentiate the various forms.*

Ocean: *I explain to learners the need for concrete objects. The use of match sticks and wooden blocks allow the learners to construct the shapes with match sticks or the wooden blocks in both numeric and geometric patterns. I use charts on different types of shapes and concrete objects to assist the learners establish the idea of geometric patterns.*

Delta: *I use pattern blocks, number cards in the lesson; for instance, I give learners a set of pattern blocks and I ask them to recreate a given design using the pattern blocks. I give the learners another set of pattern blocks to create the same shape but this time a much bigger one. I then ask*

the learners to explain to me what caused the increase in size, but the shapes are the same. I use this method to assist learners find the common change in the created shape in the geometric patterns. I provide a worksheet with different numeric patterns, allowing learners to practice identifying and extending patterns. I use number lines and counters to extend patterns on a given chart for learners to visualise a given pattern.

Seed: *I use colour counters and beads to demonstrate the growth of a certain, for instance, if exploring the sequence 2; 4; 6; 8; ... I use the colour counters and the beads to represent each term and show how the pattern is continuous. Creating the shapes with the beads or representing the terms with the beads assists the learners to identify the common change in the pattern. I design worksheets in the form of a chart to assist learners to identify and differentiate patterns, mixed patterns are given on the chart for learners to find the rules and classify the various forms of patterns.*

The teacher participants used both manipulatives and charts during their lessons. They also designed worksheets to assist the learners in comprehending the learning of Number Patterns. The data shows that Delta and River used matchsticks, paper cards, wooden blocks, bottle tops, pattern blocks, counting beads, and number tiles to facilitate learners' understanding of Number Patterns. Teachers allowed learners to use the objects to create numeric and geometric patterns and extend the patterns through a constant value. Seed used beads to illustrate continuity of patterns and the idea of place value from their previous knowledge. This was achieved by using objects to illustrate the concept, making the learning of Number Patterns more practical than abstract. The use of manipulatives in the lesson needed good organisational skills of the teacher and good pedagogical knowledge to keep the aim and objectives of the lesson in focus.

Delta revealed that he used manipulatives to determine the common change in patterns. Good classroom control and management are required to maintain a disciplined class when manipulatives are used as teaching aids. There is a need to control the overexcitement of learners to maintain the right classroom atmosphere. Delta explained that they used concrete objects like counters to extend patterns. In the context of Number Patterns, the teachers allowed learners to

conceptualise and draw new ideas from social interaction with peers while interacting with physical or digital manipulatives.

The use of charts facilitates the organisation and presentation of complex information, simplifying it and making it more accessible to individual learners. River used charts to help learners compare and differentiate numeric and geometric patterns. Seed also used charts as a visual reinforcement, bringing the ideas and concepts in a more realistic manner. Both River and Seed used charts as a way of creating a connection within the learning concepts and the methodology adopted for the lesson. The charts and worksheets were extracted from the learners' textbooks and study materials that learners were familiar with. The data from teachers' responses shows that they designed worksheets relevant to the learners' needs. Inasmuch as there were other resources for the study of mathematics, such as workbooks, textbooks, and chalkboards, the choice of charts was meant to minimise the load of learners in finding information.

For Delta and Ocean, the use of concrete manipulatives helped in making geometric patterns more real to the learners. The concept of connecting the form of an object with the growth in dimensions of successive shapes can be demonstrated through the application of manipulatives throughout the lesson. The use of manipulatives in the classroom, according to Delta, has some challenges in maintaining order in the classroom while utilising manipulatives. As stated by Mulligan and Mitchlemore (2009), teachers need training to be able to use manipulatives effectively in their lessons. Learners are affected due to the lack of skill by a teacher on how to incorporate concrete objects into the learning of Number Patterns. Time management during the lesson is a challenge to teachers, as the use of concrete objects is more time-consuming (Van de Walle et al., 2018). On many occasions, teachers and learners need to create or design the concrete materials needed for that lesson. The use of manipulatives challenges teachers to relook into the methodology chosen for the lesson to accommodate every learner.

In making the lesson on Number Patterns effective in the classroom, different manipulatives must be incorporated to cater for different learning styles (Hativa, 2013) This helps in connecting the abstract representation into a more solidified understanding of patterns (Sinclair & Crespo, 2017). Manipulatives are valuable teaching aids in numeric and geometric patterns and incorporating

these concrete objects into any mathematics teaching permits teachers to emphasise on deep understanding of the concept, improve visualisation, and enhance learner engagement in the classroom. as stated by Knuth and Stephens (2018), the utilization of manipulatives improves learners' conceptual comprehension in a mathematics setting. Vygotsky (1978) posits that learners construct their own knowledge through social interaction with peers, teachers, and their environment.

The response from Mr. Seed indicated that proper planning is needed to use concrete objects in the lesson. Designing worksheets to cater to learners' needs during the lesson reveals that the teacher participants put in effort to ensure that learners understood the concept of Number Patterns. Wiggins and McTighe (2005) state that charts offer constructive feedback to learners, which facilitates improvement. Teachers use charts to build ideas in the learners' minds, and as they visualise and interact with the chart, new thoughts are created that improve the critical thinking skills of the learners. Even though charts add value to the teaching and learning of Number Patterns, overreliance on charts in the lesson has its own challenges for the learners. Overuse of charts results in learners' inability to engage in critical thinking and problem-solving. The interaction between the teacher and learners can be limited by the excessive use of charts in the lesson. Sinclair and Crespo (2017) state that the use of charts on complex information can overwhelm learners and hinder learner understanding.

Webb (2009) articulates that worksheets offer learners an opportunity to practice and apply newly acquired skills. Worksheets such as math problem worksheets, pattern completion worksheets, and geometric puzzle worksheets enhance the understanding of new concepts in the mathematics classroom (Knuth & Stephens, 2018; Mulligan & Mitchelmore, 2009; Gutierrez & Jaime, 2015).

5.2.2.2 Integrate mathematical concepts to teach number patterns

This section describes the different mathematical concepts that teachers integrated during the teaching of Number Patterns. Integration of concepts in a mathematics lesson is the intentional connection and blending of other mathematical ideas, skills, procedures, and processes that enhance a deeper understanding of the concepts being discussed or taught in the classroom, making learning more meaningful and facilitating easy transfer and development of knowledge.

The responses from teachers below indicate the concepts teachers integrated into their lessons when teaching number patterns:

River: *I use flow diagram from the concept of functions to ensure that the idea of input and output are integrated into the finding of the rule of the pattern. I also introduce the operational systems in numbers to assist learners in generating and extending patterns.*

Ocean: *I integrate my lesson with counting and exponents, flow diagram from functions to make it easier for learners to create new patterns.*

Delta: *I use flow diagram from the concept of functions and the concept of integers at the introduction part of my lesson when asking questions on the previous knowledge of the learners, that is when I integrate flow diagram and integers to develop the idea of patterns.*

Seed: *I integrate concepts in Number Patterns such as operations, exponents, forms of number (odd, even, and composite numbers), and flow diagram from functions to create a link between what they know and the new concept of Number Patterns. Integration enables learners to comprehend that mathematics cannot be studied in isolation, thereby encouraging them to think generally and maintain open minds, which helps during the teaching and learning of Number Patterns. The challenge of integration is how to manage your time as a teacher and not focusing on the integrated concept rather than the Number Patterns you are teaching.*

The teachers' responses indicate that teachers integrated concepts within mathematics. River and Ocean integrated the flow diagram from the concept of function into the teaching of Number Patterns to assist learners in developing the relationship between terms in the sequence of numbers in any pattern. The linking of concepts in any mathematics lesson is to create the idea within learners that Number Patterns cannot be learned in isolation from other mathematical concepts. As a researcher, the idea of teachers integrating other mathematical concepts into the teaching of Number Patterns indicates that teachers have a deeper knowledge and understanding of the concepts that can assist learners in developing a better understanding of patterns.

Delta used a flow diagram as an introduction part of his lesson, which reveals that the previous knowledge of the learners is considered, allowing the teacher to build from the known to the

unknown. Teachers identified the different points or parts of the lesson where integration was necessary without overloading the learners with numerous concepts and creating a burden for learners to comprehend the concept of Number Patterns. It is ideally challenging for teachers to teach Number Patterns without incorporating other mathematical concepts utilised at various stages of the lesson. The idea of integration is critical for mathematics teachers at the primary level who must break down complex concepts into smaller chunks and integrate other concepts to derive a deeper meaning and understanding for the learners.

In as much as integration of mathematical concepts enhances learners understanding, it becomes overwhelming to learners in situations where proper care is not taken by the teacher. The integration of concepts depends on teachers' knowledge and ability to structure the lesson in a more concise manner.

It is evident from the data generated from the teachers' responses that the concepts integrated into their lesson during the teaching of Number Patterns only deepened the learners' understanding of numeric patterns without paying attention to concepts in mathematics that enhance the understanding of geometric patterns. The teachers used concrete objects and figures to assist learners to understand geometric patterns and connect the abstract learning to a more real-world context. Mathematical concepts such as spatial reasoning, symmetry of shapes, geometric transformation, and tessellations were not integrated into the lesson to give learners an opportunity to develop more knowledge on visualisation of patterns, spatial awareness, and the exploration of geometric relationships. Furthermore, concepts such as data collection and analysis, graphical representation, and statistical thinking can also be integrated into the teaching of Number Patterns to develop learners' understanding of measurement and data analysis concepts (Van de Walle et al., 2018; Webb, 2009; Wiggins & McTighe, 2005).

As stated by Kilpatrick et al. (2015), intra-mathematical integration connects concepts within mathematics, such as algebra and geometry, Number Patterns and functions. The idea of integration becomes a constraint to curriculum coverage where teachers need to find a balance on curriculum requirements and learners understanding through integration of other concepts (Wiggins & McTighe, 2005).

The feedback from Seed suggests that integrating Number Patterns into teaching poses a challenge that necessitates additional teaching time. Teachers require more teaching time when teaching Number Patterns to facilitate integration of concepts that assist learners in cultivating problem-solving and critical thinking skills (Sinclair & Crespo, 2017). From the responses of Delta and River on integration, it is obvious that integration contributes positively to learners understanding, making it a necessary requirement for the teaching of both numeric and geometric patterns. Extending learners' knowledge and understanding through integration of concepts within mathematics also exposes learners to integration of learning areas such as technology and mathematics, natural sciences and mathematics at the primary school level.

Kieran (2006) alludes that integration is essential for algebraic thinking, which is a basis for understanding number patterns, particularly the aspect of recognising and extending sequences. In support of Kieran (2006), variables and expressions, functional relationships, and graphical representation enable learners to identify patterns in a sequence, develop generalisations and rules, analyse and solve problems (Mulligan & Mitchelmore, 2009; Knuth & Stephens, 2018; Sinclair & Crespo, 2017).

According to the experiences of the individual teacher participants, integrating other mathematical concepts into the teaching of Number Patterns is important and crucial for fostering deeper understanding of both numeric and geometric connections between mathematical ideas, and for developing problem-solving skills in algebraic thinking, as well as skills in measurement and data analysis.

5.2.2.3 Using guided observation to determine the common change in number patterns

Observation is a critical skill that plays a crucial role in the identification of patterns and determining the common change in both numeric and geometric patterns. In observation the learners are given an opportunity to carefully examine the pattern and discover the underlying rule generating and governing the sequence of numbers within a pattern. The data reveals that teachers gave learners numerous patterns and asked them to observe and identify any common trends in the pattern. The following data was generated from the semi-structured interview session:

River: *I ask the learners to study the pattern carefully, identify the common change and then come up with a concluding statement and that helps the learners in finding the rule of a particular pattern. I use activities from the textbook and the DBE mathematics activity book; I facilitate the process by giving learners guidelines and reminding them of the steps to follow in finding the rule.*

Ocean: *I ask the learners to first identify the common change in the pattern through careful observation of the given pattern. Learners also use flow diagrams or table of patterns to assist them to differentiate the various forms of patterns before finding the rule of that pattern. I gave the learners activities from the worksheet I designed on patterns, allowing them to work in groups which promote collaboration and social learning.*

Delta: *in guiding learners to find the rule of the pattern, for instance, 3; 6; 9; 12; The learners first identify the common change which is “adding 3” learners identify common difference and the constant ratio. I then give them instructions as to how to generate the rule of the given pattern.*

Seed: *I write patterns on the board, for instance, 2; 4; 6; 8; Then I ask learners to find the rule by first predicting and then later using the common difference between the consecutive terms to find the rule of the pattern. Incorporating with electronic videos how patterns are formed, which helps the learners to find the rules of any given pattern.*

The learners are reminded by the teacher participants how patterns are generated and that they assisted the learners to use that process of pattern formation to identify the rules. Delta and Seed created patterns such as 3; 6; 9; 12; The patterns created gave the learners an idea of how to generate patterns by observation and guided instructions from Delta and Seed. In geometric patterns, the teachers used shapes and figures that followed a specific rule aligning it with their properties such as symmetry and tessellation.

According to River, the learners in her class are allowed to carefully study a given pattern with an task to find the given rule. It was also indicated by River that learners could also use guidelines provided by her during the lesson. The individual teacher participants allowed learners to share their observations and findings through collaborative activities. For instance, Delta and Seed both created patterns for learners to observe in pairs, allowing the learners to discuss, which promoted

learners' learning and understanding. Finding the rules of different numeric and geometric patterns through observation was discussed by the individual teacher participants with more emphasis on numeric patterns and using the concept of constant difference to find the rule. Ocean made the learning process more flexible and easier for the learners by creating a worksheet of patterns and encouraging learners to identify the different forms of patterns. The learners were guided during observation by the leading questions of the teacher participants to create their own patterns and find the rule. To enhance observation, the use of visual technology can assist learners to explore patterns (Hativa, 2013) and learners collaborating with peers to share observations and insights (Webb, 2009).

According to Hativa (2013), using visual aids like diagrams and graphs assist the learners to identify the common change in a pattern. The teachers used mathematical equations to represent the rule of any given patterns once the common change is identified by the learners during the lesson. The teachers align their approaches with the abilities of the learners through differentiated learning. According to Vygotsky (1978), ZPD is crucial to learners developing new ideas from what the teacher has already introduced to the learners. The explanations given to learners by the teacher on how to find the rules of a given pattern create a platform for learners to build on their existing knowledge to create new ideas and knowledge.

The use of video presentation by Seed as an introduction to how patterns are formed influences the ZPD of the learners positively, linking the video experience with the new ideas through the rule of a given pattern. River and Ocean employed a comparable method for guiding learners in discovering the rules of a specific pattern by initially enabling them to meticulously observe the pattern prior to recognising the shared alteration. This shows that more time is allocated in their lesson to cater to the learners struggling to find the rule of a pattern.

According to Mulligan and Mitchelmore (2009), asking learners to observe and extend patterns assists learners in demonstrating their understanding of underlying relationships in any given pattern. This implies that, by developing effective observation skills and using collaborative activities, learners can uncover the underlying rules of a pattern. According to Mulligan and Mitchelmore (2009), numeric patterns involve sequences of numbers that use a specific rule. To

identify a common change in a numeric pattern, one must identify the difference between consecutive terms (Kieran, 2006) and look for repeating patterns in each sequence (Knuth & Stephens, 2018).

5.2.3 THEME 3

THE EXPERIENCE OF USING A RELEVANT TEACHING APPROACH IN TEACHING NUMBER PATTERNS

This segment of data presentation examines the methods employed by teachers in teaching Number Patterns within their lessons. This theme is further divided into four sub-themes, specifically: scaffolding throughout the lesson by posing questions that direct learners' thinking and providing temporary assistance to help learners complete a task, monitoring and shaping learners' responses during the teaching and learning process in the classroom, facilitating the learning process by giving learners' opportunity to express themselves and maintaining order and discipline during discussion sessions, explaining concepts within number patterns and other mathematical concepts that were integrated into the lesson. An effective teacher's approach to teaching Number Patterns is crucial for fostering learners' understanding and engagement in a particular lesson.

Teachers' approaches are normally built on their experiences of teaching and the type of methodology that they adopt in the classroom. When teaching Number Patterns, teachers incorporate different strategies and approaches with the learners in mind. Teachers mostly use approaches that they were introduced to during their training as mathematics teachers, and many continue to stick to these traditional approaches in their classrooms. In this current study, the responses from the teachers indicated that teachers used both traditional and contemporary approaches in teaching Number Patterns.

A teacher's methodology is influenced by the depth of knowledge and comprehension they possess regarding a specific approach to teaching Number Patterns. Teachers choose an approach built on the prior knowledge of learners, where the teacher contextualises the topic by merging it with what learners already know. Most teachers begin their lesson with an explanation of the concept of Number Patterns as their introduction and highlighting the need for the study of that concept. This notion is supported by Mulligan and Mitchelmore (2009), who note that teachers use their ability of contextualisation to connect and align their lesson with the previous knowledge of the learners

during the introduction part of their lesson. In promoting active learning in the classroom, the approach of the teacher as a facilitator is vital to the knowledge construction of the learners. The discovery and exploration part of the lesson is very important (Knuth & Stephens, 2018). From the data generated, teachers incorporate concrete objects, visual aids, and software to explore and generate patterns.

Webb (2009) states that in fostering social learning and peer-to-peer discussions, the teacher must incorporate collaborative activities as an approach to teaching Number Patterns. Using group work where learners share ideas and justify their pattern extensions. Generally, teachers separate the numeric and geometric patterns in terms of numbers and shapes, that is, differentiating between numeric and geometric patterns. Terminologies used by teachers in the lesson are mostly restricted to the aspect of patterns being taught, allowing learners to distinguish between the various forms of patterns.

During the semi-structured interview and the classroom observation, teachers' responses and expressions portray the notion that Number Patterns was a very easy concept to teach and for learners to understand. The teachers placed more emphasis on the numeric patterns, which mostly required addition or subtraction to generate and extend a given pattern. The examples and activities were mostly numeric, and little effort was placed on geometric patterns. The link between geometric figures and mathematical expressions was a challenge for the learners to comprehend. As a researcher, I attributed this challenge to the lack of teachers' integration of geometric concepts into the teaching of geometric patterns. This implies that teachers provide guided strategies to learners on developing algebraic thinking (Kieran, 2006) and introducing geometric connections (Gutierrez & Jaime, 2005), which can place more emphasis on problem-solving strategies (Sinclair & Crespo, 2017). According to Mulligan and Mitchelmore (2009), teachers can monitor learners' understanding on geometric patterns that can have a positive impact on the learners.

Sub-Themes:

5.2.3.1 Scaffolding through questioning

Scaffolding is a teaching strategy where a more knowledgeable person (teacher or peer) provides temporary, tailored support to help a learner achieve a specific task or concept. The support is gradually removed as the learner becomes more competent. Scaffolding focuses on guided support

to build individual skills. The responses of teachers from the interview show the extent to which the scaffolding approach is used in assisting learners:

River: *I ask learners leading questions to help them understand the concept of Number Patterns. Following up on their responses with questions and directing and shaping their response toward the desired outcome.*

Ocean: *During the class discussion, I move around the class assisting learners to find solutions by asking leading questions to assist each group in answering in completing the given task.*

Delta: *I give learners probing questions to assist in arriving at the desired outcome or solution. Breaking the concept into small components to allow learners to understand the procedure been responsible for their own learning.*

Seed: *In assisting learners, I give the learners the key ideas for the learners to build upon it and develop their knowledge and assumption in the classroom.*

Based on the experiences of the teachers, it is evident that in teaching Number Patterns, learners need guidance to navigate through the concepts of Number Patterns. The role of the teacher, through scaffolding, creates the possibility for the learners to measure their potential by following the guidance given to achieve the desired outcome. The response of Seed, “*I give learners key ideas for them to build upon it*” indicates that mathematics learning is dependent on the key ideas provided by the teacher through scaffolding, building a temporary platform for knowledge development among the learners. From every indication, teachers require special skills to scaffold learners through a certain concept.

Teachers need to understand their role as facilitators and mediators of the learning process. Scaffolding needs to take into account the level of understanding of individual learners, adopting a teaching method that accommodates every learner in the classroom. The aim of scaffolding is to lead the learner through a routine and gradually transfer the total responsibility of the learning process to the learner.

In teaching the concept of Number Patterns, learners are required to find the common change, extend patterns, and find the rule of a pattern. Teachers use scaffolding to get the learners

acquainted with all procedures necessary to complete the task. The idea of teachers assisting learners through scaffolding is to break down a complex task into small, manageable components, give feedback and basic support to the learners, and gradually allow the learners to take responsibility for the entire learning process.

This idea assists in modeling the thought process of the learner and aligning themselves with the peer-to-peer support and feedback from the teacher. According to Koehler and Mishra (2009), teachers can use digital tools to provide scaffolding support to learners during the teaching and learning of Number Patterns. In support of Koehler and Mishra (2009), multimedia resources such as videos, podcasts, and simulations can be incorporated into the lesson as alternative means of scaffolding (Hativa, 2013). With all the positive benefits that come with the scaffolding approach, teachers are confronted with challenges and limitations in implementing effective scaffolding during the teaching of Number Patterns.

According to the National Research Council (2004), teachers require knowledge and adaptability skills to implement effective scaffolding processes in the classroom. The idea of balancing scaffolding demands with other teaching demands is a huge challenge for teachers, especially when the class has diverse learner abilities within the same class (Tomlinson, 2001). This implies that teachers must adapt scaffolding to accommodate varying styles and different cognitive abilities of the learners (Flavell, 1979). According to Mulligan and Mitchelmore (2009), teachers can provide support to learners through scaffolding in the form of identifying patterns.

According to Vygotsky (1978), scaffolding in the social learning classroom has an impact on learners' understanding and development, which provides temporary support and guidance, creating a platform for learners' understanding and mastery of complex concepts and completion of tasks in the classroom. In developing critical thinking among learners, teachers can use scaffolding to enhance problem-solving skills and cognitive processes during the teaching and learning of Number Patterns. It is clear from the responses of teachers that scaffolding builds up the confidence of learners to develop their own ideas through the guidance of the teacher.

Flavell (1979) suggests that metacognitive skills can be developed within learners through scaffolding, articulating learners' self-regulation, and reflective skills. In social learning,

scaffolding can foster collaboration and social interactions among learners (Wertsch, 1979). In addition, Johnson and Johnson (2009), state that social scaffolding fosters effective teamwork and communication.

5.2.3.2 Monitoring and shaping learner responses

Monitoring learners' progress and shaping learners' ideas and thoughts is a major responsibility of a classroom teacher. Monitoring plays an important role in a classroom where social learning is encouraged. For teachers to track the progress of learners, a proper monitoring strategy must be implemented by the teacher. The responses of teachers below indicate their perspective of monitoring during the teaching of Number Patterns:

River: *I monitor the group work and assist groups that are struggling with the task. I give more guidance to the group to shape their thinking and the ideas they develop.*

Ocean: *minor misconceptions are corrected during the monitoring and recap of the lesson. Guidance is given to learners to bring all the learners to the same level of understanding during the classroom discussion.*

Delta: *During the classroom discussions, I move around the class to monitor the group discussions, engaging with the group and listening to their arguments and findings to ensure that each learner is given a fair chance to state their opinions in their groups.*

Seed: *I monitor and listen to the learners attentively during class discussions and provide feedback and direction to the arguments made by the learners on the topic. I guide the learners to combine the ideas and opinions into a meaningful mathematical concept.*

The response of Delta and Seed indicated that monitoring the learning habits of the learners demanded that the teacher be engaged with the learners during the lesson. The response of Ocean indicated that monitoring of learners during teaching and learning assists the teacher to recap what learners have learnt and understood. The responses from the teacher participants indicated that collaborative learning encouraged us to share ideas and opinions. Effective monitoring ensures that learners achieve learning objectives and develop a deeper understanding of the subject matter

under discussion. Monitoring, according to River, assists teachers in giving more guidance to learners during the lesson.

Group work and peer-to-peer teaching can function properly if teachers implement proper monitoring and guidance strategies to regulate the engagement of learners during collaborative tasks and classroom dialogues. Monitoring and guidance allow learners to reflect on their learning and evaluate their grasp of concepts and skills (Mulligan & Mitchelmore, 2009). Conceptual errors can be picked up and corrected when effective monitoring is put in place during the teaching of Number Patterns. Lack of interest in learning, mathematical content errors, and gaps become rampant in the learning of mathematics, and learners feel neglected when teachers fail to monitor learners' work properly.

Teachers employ numerous strategies to monitor and guide learners to evaluate and inform their instruction in the classroom. Teachers can adjust teaching methods to meet learners' needs when content gaps are identified through monitoring. Learners claim ownership of their work when a teacher pays more attention to monitoring their work. Monitoring and guidance of learners' learning is a continuous process that must take place at every stage of the learning process. The system of monitoring adopted by the teachers in this study is verbal monitoring, and no attention was paid to digital means of monitoring learners' work in the classroom. The use of learning management systems can be used by teachers to monitor and track the progress through engagement of the learner in the classroom (Waston et al., 2017).

Teachers' experience indicates that monitoring is used as one of the measures to maintain classroom order during and after the lesson. The benefit of monitoring in any mathematics classroom creates an atmosphere of care from the teachers to learners and a cordial relationship between the learners and the teacher. Many classroom challenges that teachers face in teaching Number Patterns are because of teachers not monitoring learners properly. The observation of learners presents specific challenges for teachers as they strive to balance curriculum delivery with the assessment of learners (Webb, 2009). In assisting learners to construct their own knowledge through teachers' monitoring, learners must be encouraged to do personal reflection, implement a system of accountability for their progress in the classroom, and ask for guidance and assistance

from their peers. Knuth and Stephens (2018) note that monitoring of learning gives the teacher an opportunity to identify knowledge gaps among learners and pinpoint areas where learners need additional support.

According to Wiggins and McTighe (2005), summative assessment can form a comprehensive evaluation to measure and monitor learners' learning outcomes. Monitoring and guidance should be complemented by teachers' feedback to learners, making the learners aware of the level of their performance. Ocean stated that *Minor misconceptions are corrected during monitoring*. This indicates that the teachers make themselves available for questioning and assisting learners during the class discussions, moving around in the classroom, observing the way learners present their arguments, and ensuring their viewpoints are recognised by their peers. In the classroom that fosters social learning, the teachers work together with learners to monitor their own progress and set goals for the learner (Black & William, 2009).

From the social constructivist viewpoint, Vygotsky (1978) says monitoring of learners' learning creates a social interaction between the teacher and learners through facilitation and discussions. This agrees with the response of Seed, who stated that *"I listen to learners attentively and provide feedback to the learners."* Supporting this response, Delta added that *"I move around the classroom engaging with the groups and listening to their arguments and their findings."* According to Black and William (2009), monitoring of learners' learning through assessment is an ongoing formal or informal task. Monitoring is vital in the teaching and learning of Number Patterns, emphasising collaboration, interaction, and active participation of learners. Effective monitoring can foster deeper understanding, improve learners' motivation, and develop metacognitive skills.

5.2.3.3 Facilitating the learning process

From the teacher participants' articulation, one of the roles mathematics teachers adopt is the role of a facilitator. Facilitation is a critical role in the mathematics classroom, especially when dealing with the concept of Number Patterns. The following responses of teachers confirmed their stands on facilitation:

River: *I facilitate the lesson by allowing the learners to choose partners, creating that friendly atmosphere and getting the learners mentally prepared for the lesson by asking random questions and scaffolding the learners to create discussion on number patterns.*

Ocean: *I generally talk about patterns and during the class discussion I restrict the discussions to numbers by facilitating the learning process. I ask learners questions and respond to learners' questions. I give learners the opportunity to share their findings in the class with peers. I literally rotate the learners' turns in speaking to minimise the noise levels in the classroom during discussions.*

Delta: *I encouraged learners to read instructions given in a task, controlling the class discussions and making sure the discussion is not outside Number Patterns. I use open-ended and close-ended questions to channel the discussion, giving probing questions to foster critical thinking and problem-solving skills among the learners.*

Seed clarifies that: *"I utilised video illustrations of patterns, which aids in the facilitation of the lesson; tangible objects are incorporated in the video illustrations, thereby assisting learners in connecting concepts from concrete to the abstract".*

The position of teachers in facilitation can help learners achieve and operate at their maximum potential, or it can cause learners to lose interest in learning mathematics. Effective facilitation can enable learners to construct their own understanding, develop problem-solving skills, and open learners' appreciation of mathematics. During the semi-structured interview, it was established that Ocean created an atmosphere that is very receptive to the teaching and learning of Number Patterns through shared ideas and opinions of learners. The teachers used questioning and illustrations to get the learners mentally ready for the lesson. As facilitators of the learning process, Delta responded that teachers must be flexible, open-minded, and focused on every aspect of the lesson. The teachers' observational ability, monitoring skills, and guidance of the learners' reasoning determined the effectiveness of the lesson.

The purpose of facilitating a lesson is to get learners actively engaged in the lesson by creating a platform for the learners to interact with the concept of Number Patterns. The use of video captured

the learners' attention, and with guidance from the video illustrations, using concrete objects made the lesson more practical. In support of Seed, the use of digital tools by learners in Number Patterns assists learners to explore and generate patterns, promote learner engagement and understanding (Gutierrez & Jaime, 2015). Furthermore, Knuth and Stephens (2018) also attest to the use of concrete materials such as blocks, number tiles, and visual manipulatives in facilitating a lesson in Number Patterns.

By incorporating tangible objects into the educational process, teachers guide and facilitate the lesson to foster a supportive environment for effective teaching and learning within the classroom. Delta explained that adequate help was given to the learners at every stage of the lesson, as explaining is expected of the learners to do at any point. The slow learners in the class were overwhelmed with the numerous strategies and kept asking the teachers repeatedly to re-explain the strategies. Inasmuch as facilitation reduces the percentage of teacher involvement in knowledge construction within the social learning classroom, teachers face the challenge of adapting their teaching methods to cater to the different learner abilities, managing group work, and maintaining focus on the content being discussed.

To address the challenge faced by teachers during facilitation, Gutierrez and Jaime (2015) suggest that teachers must be able to adjust their facilitation strategies to accommodate varying learning styles and abilities within the classroom. In addition, Knuth and Stephens (2018) state that time is a constraint when teachers use facilitation as an approach in their lessons; therefore, teachers require careful planning and precise strategies, and good time management skills to facilitate effective lessons. According to Mulligan and Mitchelmore (2009), questioning in facilitation encourages learners' critical thinking and problem-solving skills. Furthermore, Mulligan and Mitchelmore (2009) state that for encouraging learners' exploration ability and discovery skills, open-ended questions such as "What pattern do you see in the sequence?" can be asked by a facilitator.

Teachers' experiences on facilitation align with the constructivist view, which emphasises the teachers' role as a co-learner in the social constructivist classroom. A facilitator, as noted by De Witt and Lessing (2013), asserts that a teacher who can cultivate a classroom atmosphere where

learners value each learning opportunity, develop cognitive skills, make sense of the knowledge being attained, and develop new ideas. In a social learning classroom, Vygotsky (1978) argues that effective facilitation must activate knowledge construction among learners through experiences and social interaction.

From the standpoint of De Witt and Lessing (2013) and Vygotsky (1978) above, effective facilitation must be driven by learning outcomes in a mathematics classroom, which can be achieved through a learner-centred approach. The teachers adapted their classroom structure into flexible groups to cater to learners' learning needs. Engaging in a learner-centred approach, learners are motivated to construct their own understanding. Concluding from the data analysis, the role of teachers as facilitators is essential when addressing intricate concepts such as Number Patterns. Effective facilitation promotes deep understanding of mathematical concepts and develops problem-solving skills.

5.2.4 THEME 4

DEVELOPING CRITICAL THINKING SKILLS

The analysis of the data uncovered the strategies and methods employed by teachers in fostering critical thinking ability while teaching and learning Number Patterns. In the teaching, learning, and understanding of patterns, learners are required to systematically evaluate, analyse information, and communicate ideas within the concept of Number Patterns. The process of developing critical thinking skills involves analytical thinking and problem-solving within the classroom.

Sub-Theme

5.2.4.1 Communicating mathematical ideas and knowledge

Strong communication skills are essential for developing critical thinkers within the mathematics classroom. Communication of mathematical ideas and knowledge enhances concept development in understanding Number Patterns. Developing critical thinking through communication, the learners should be able to reflect and analyse their thought process during the lesson. The responses from teachers in the data below illustrate the various strategies that teachers employ to develop learners' critical thinking:

River: *I ask learners to re-explain their responses and justify their opinions in the class discussions. I create scenarios using ages of learners and I allow the learners to use the information to create patterns out of the given scenario.*

Ocean: *I ask the learners to justify their answers and relating patterns to other concepts in mathematics, learners discuss their challenges in the lesson which provides the learners an opportunity to think critically.*

Delta: *I promote logical thinking, learners analyse sequences, identify rules of patterns, make predictions, and justify every response made by the learners. I encourage learners to identify patterns around them, for instance, patterns in nature such as art, music, and concrete objects, which learners connect situations such as financial calculations, growth rate, and scientific data to enhance learners' critical thinking skills.*

Seed: *I promote critical thinking through problem-solving activities where learners use their own strategies to find solutions which need them to apply deeper knowledge and justification to find the solution. The learners also analyse the problems before they attempt to solve the problem.*

In promoting in-depth knowledge and understanding of critical thinking skills, Seed used pattern blocks to challenge learners to create and extend both numeric and geometric patterns. Through the pattern blocks, the learners are encouraged to justify their patterns and explore numerous variations. Delta and Ocean presented learners with a sequence of numbers where the learners identified the pattern, predicted the next consecutive terms, and found the general rule of the pattern.

Even though teacher participants used numerous ways to achieve learners' critical thinking skills, teachers faced the challenge of time to integrate critical thinking activities into the lesson, which requires proper planning and good time management. The factor of learner diversity in the classroom contributes to the challenge of implementing critical thinking skills. Learners' needs must be considered when planning the lesson. The findings show that in overcoming such challenges, teachers emphasise higher-order thinking skills through analysis, evaluation, justification, predictions, and the creation of new patterns. In concluding teachers' experiences as

revealed by the data, developing critical thinking skills is crucial in teaching numeric and geometric patterns in Grade 7. Teachers used different measures, including open-ended questions, practical activities, and real-world applications, in assisting learners. Practical activities such as pattern blocks and number sequences were employed to foster critical thinking. Integration of technology and digital tools, and practical illustrations, assisted in developing the critical thinking skills of the learners.

The development of critical thinking skills fosters problem-solving skills and mathematical reasoning. The teachers promoted critical thinking skills by allowing learners to justify and analyse their responses in the classroom, through problem-solving activities and promoting logical thinking and mathematical reasoning in their answers. According to Mulligan and Mitchelmore (2009), teachers employ open-ended questions to encourage learners to explore and justify Number Patterns. The use of investigative and discovery learning can enhance learners' critical thinking skills through hands-on activities in the classroom (Knuth & Stephens, 2018). In a social learning classroom, teachers adopt various strategies such as collaborative learning, using practical concrete objects, and peer teaching to develop critical thinking skills.

In social constructivism, teachers can use social interaction and collaborative learning to enhance learners' critical thinking abilities in the classroom (Vygotsky, 1978). In support of the above, the teachers used more interactive activities in their lessons to reinforce the idea of critical thinking through logical reasoning. In developing critical thinking skills among learners, the teachers further used real-world applications to assist learners in thinking and reasoning logically in their application of patterns outside the educational environment.

5.3 IN WHAT WAYS DO TEACHERS' EXPERIENCES INFLUENCE THEIR APPROACHES TO TEACHING NUMBER PATTERNS IN GRADE 7?

5.3.1 Findings from classroom lesson observations

I observed three teacher participants out of the four participants who took part in the study. The three participants presented a lesson on Number Patterns, and the following aspects of the lesson were observed:

- Teachers' classroom organisation and learner preparedness for the lesson.

- Teachers' feedback to learners on their questions and responses during the lesson.
- Teachers' organisational ability in terms of lesson preparation, objectives and aim of the lesson have been clearly defined.
- Teachers' approach to the teaching of the concept of Number Patterns.

The participants observed were River, Delta, and Seed. The three participants placed more emphasis on creating numeric and geometric patterns, extension of numeric patterns, finding the rule of a numeric pattern, and differentiating the various forms of patterns.

5.3.2 In River's classroom

The lesson commenced with a review of the learners' prior understanding of the concept of numbers. Following this, River led a general discussion on patterns and their various forms. The learners were tasked with creating their own patterns, with the initial term of the pattern supplied by the teacher, along with the constant difference to enable the learners to extend the pattern. The learners generated patterns such as: (a) 2; 4; 6; 8; (b) 3; 6; 9; 12; (c) 10; 8; 6; 4; River elucidated the techniques for identifying the principles of numeric patterns, following which the learners were tasked with determining the rules of the patterns they had created.

The classroom was well organised with learners seated in pairs and in rows, allowing easy access for the teacher to learners during the lesson. The walls in the classroom were decorated with charts on mathematical concepts, making the classroom atmosphere conducive to the learning of mathematics. River provided feedback to the learners at various points throughout the lesson and asked the learners to answer questions she posed. The learners were fully engaged in the lesson during the discussion by asking questions and responding to the teachers' questions. River stated the objectives of the lesson to the learners, explaining clearly what she expected learners to achieve at the end of the lesson. River summarised the main ideas of the lesson and gave the learners more time to respond to questions during the lesson.

5.3.3 In Delta's classroom

The lesson commenced with an overview of the concepts of Number Patterns, including examples of various patterns, and elucidating to learners the importance of patterns in mathematics. The teacher exhibited a strong understanding of the concept of Number Patterns. The learners were

requested and encouraged to create their own patterns, using their previous knowledge to establish the concept of Number Patterns. Delta created a conducive classroom atmosphere for the learners to participate in the lesson. The learners were allowed to express themselves and share their knowledge of Number Patterns. The approach of Delta in his lesson was more learner-centred, with more opportunities for learners to develop their own knowledge. Delta used individual learner responses as opposed to group responses. The learners were put into groups of four before the lesson started. The classroom environment was calm, even with my presence in the classroom, with learners ready to participate in the lesson. The learners came to the class with concrete objects to construct patterns during the lesson. The teacher formed the groups in the class to make it easier for the teacher to address learner challenges during the lesson. Delta gave feedback to the learners during the class activity and requested that the learners respond to questions to allow him to check the intellectual ability of the learners. Delta used professionalism and friendly language to interact with the learners. The learners were allowed to interact with each other and respond through peer feedback.

5.3.4 In Seed's classroom:

The lesson started with a verbal introduction and clarity to the learners on the aims and outcomes of the lesson. Seed used technology in making the lesson interesting, using a worksheet specifically designed for learner involvement in the discussion. Seed utilised examples that are straightforward and easily understandable for learners to grasp. Instances of patterns developed by learners consist of: (a) 1; 5; 9; 13; (b) 15; 11; 7; 3; -1; (c) 1; 1.5; 2; 2.5; 3; Seed used a more individual learner approach to teaching and learning. Seed continuously gave feedback to the learners throughout the lesson. The expectations of learners in the lesson were made known to the learners. Seed exhibited effective command and control over the classroom, fostering increased interaction among the learners. Seed identified learners with challenges and gave feedback through scaffolding the learners into understanding the concept of Number Patterns. The learners were seated individually and in rows during the lesson, which was suitable for the teacher to do one-on-one teacher-learner teaching. The teacher went to individual learners to address their challenges during the lesson. The classroom was well-resourced with laptops and projectors that were set for

the lesson. The teacher utilised a PowerPoint presentation during his lessons, which generated enthusiasm among the learners.

5.3.5 Analysis of the classroom lesson observation

The lesson observations were conducted in three distinct schools located within the same local municipality. The teachers in the study had their classrooms organised with a seating arrangement that was suitable for the methods, approach, and strategies chosen for the lesson. The classroom environment of the teacher contributes to the learners' engagement during the teaching and learning process. During the observation, I noticed that the arrangement of the classroom made it easier for the teacher to move around the classroom to help the learners who were struggling. Learners showed a sense of readiness, and all teaching and learning materials were available for the lesson. The teacher's interaction with learners during lessons depended on how the classrooms were arranged. Teaching mathematics in a friendly atmosphere that supports mathematics learning is crucial in the teaching and learning of Number Patterns. The display of all materials needed for the lesson, the seating arrangement, and accessibility of the teacher to the learners in the classroom were easy.

Although the three observed participants taught the same concept of Number Patterns, everyone approached their lessons in a distinct manner. The approach to teaching any concept in mathematics, especially Number Patterns, differed from teacher to teacher based on their experiences and their knowledge of selecting and using the relevant approaches and strategies in mathematics teaching. The teacher participants were very confident in the various approaches that they used during their lessons. The analysis of the classroom observation was done under the following three themes: teachers' approach to teaching Number Patterns, introduction and use of concrete objects in the lesson, and feedback to learners during the lesson.

5.3.6 Teachers' Approach to Teaching Number Patterns

The approach to the teaching of number patterns by the teacher participants builds on the previous knowledge of the learners, which created a sense of belonging or being part of the lesson, making learners take responsibility. The learners were encouraged in all the lessons observed to generate their own patterns and find the rules of the generated patterns. The approaches of the teachers to

Number Patterns depended upon their class experiences over the years. The teachers assisted the learners who were struggling in the classroom and helped the learners express their own opinions and develop their own knowledge. The lessons also indicated that the teacher participants used concrete objects and technology to assist the learners in developing an understanding of Number Patterns. In their individual lessons, teachers allowed learners to generate their own patterns and find the rules of the patterns generated. Delta and Seed used individual learner responses; however, River permitted group responses within the classroom. The teachers clarified all the terminology and provided the learners with the chance for additional explanation, thereby enhancing the comprehension of the concept of Number Patterns for the learners.

5.3.7 Introduction and Use of Concrete Objects in the Lesson

The introduction and use of concrete objects during the lesson gave the learners more understanding and deeper knowledge of Number Patterns. The management of time and resources was done properly and efficiently by the teachers during the lesson. Delta's lesson was well prepared, showing that the learning materials can be blended into the lesson without creating any confusion in the classroom. In Seed's classroom, learners were given clear objectives of the lesson, and the expectations from the teacher were made known to the learners. "Teachers who participate in thorough lesson planning are more inclined to provide effective guidelines through meticulous preparation of their lesson" (Webb, 2009, p.45). "The preparation of lessons is a vital component of teacher effectiveness" (Hativa, 2013, p.12).

The experiences of the teachers from the observation indicated that clear, specific, measurable, achievable, relevant, and time-bound objectives and aims were set during the preparation of the lesson. The teachers aligned their objectives and aims to the concept of Number Patterns and with the standard set by the mathematics curriculum for Grade 7 and the learning outcomes (Wiggins & McTighe, 2005). The teachers' organisational abilities influence the teaching and learning process, with clearer objectives promoting effective teaching in the classroom, and encouraging proper assessment and evaluation. The teaching of Number Patterns supports teachers' organisation of digital lesson planning tools, which include collaboration tools and resource sharing during the lesson (Hativa, 2013).

Inasmuch as the individual teacher participants aimed at delivering an effective lesson through their organisational abilities, Delta faced the challenge of meeting the objectives and aims of the lesson due to limited time. It was difficult for River to balance the curriculum demand with the different learner needs during the lesson, which became frustrating to some of the learners.

5.3.8 Feedback to Learners during the Lesson

Teachers' feedback in the teaching of Number Patterns serves as a stimulant to create learners' interest. The observations revealed the actual practices teachers employed in their classrooms during the lesson. River's learners were motivated and acted upon the feedback from the teacher as a means of checking and measuring their understanding. Seed responded to the learners' questions lesson which allowed most learners opportunity for follow-up questions depending on the feedback that was provided by the teacher. Feedback from teachers motivates learners to engage in critical thinking and fosters a thorough understanding, enabling them to utilised logical reasoning when seeking additional clarifications during a lesson (Mulligan & Mitchelmore, 2009). As noted by Black and William (2009), teachers offer formative feedback to learners throughout the lesson, which is intended to steer the learning process and enhance the learners' performance in the subject matter. The teachers also used feedback at the end of the lesson to check the level of understanding of the learners. Summative feedback is used to provide learners with results of their achievement in the lesson (Wiggins & McTighe, 2005).

Through the teachers' feedback, most of the learners became more focused and objective in their questioning and reasoning at the level of finding solutions to tasks in the classroom. According to Webb (2009), teachers' feedback develops learners' questioning skills, refines ideas from learners, and assists learners in asking more relevant questions during the lesson. In other words, positive feedback from teachers builds learners' confidence and promotes learner participation in the classroom (Knuth & Stephens, 2018). In Number Patterns lessons, teachers can use audio and video feedback through learning management systems (LMS) and digital annotation tools (DAT) to track the progress of learners in both written and visual feedback (Mulligan & Mitchelmore, 2009; Watson et al., 2017; Koehler & Mishra, 2009). This indicates that feedback from teachers influences the questions and responses of the learners regarding the teaching and learning of Number Patterns. It fosters critical thinking, tackles learner difficulties, and enhances the

comprehension of concepts related to Number Patterns. Teacher feedback offers learners insight into their academic performance, understanding, and advancement in the subject matter (Hativa, 2013)

5.4 CONCLUSION

The experiences of teachers teaching Grade 7 learners on Number Patterns were depicted in this study. This chapter examined the results and evaluated the data collected from semi-structured interviews and classroom observations conducted with four teachers from four distinct primary schools who were teaching mathematics to Grade 7 learners. The results were interpreted through the lens of social constructivist theory in relation to the literature reviewed in this research. The following chapter presents a summary of the entire study and an interpretation of the conclusions derived. It finally closes with recommendations drawn from the findings associated with the key research questions.

CHAPTER SIX

SUMMARY OF FINDINGS, RECOMMENDATIONS AND CONCLUSION

6.1 INTRODUCTION

The preceding chapter focused on presenting and analysing the data derived from teachers' experiences in teaching Number Patterns to Grade 7 in KwaZulu-Natal. The objective of this chapter is to reflect on the study and provide a comprehensive summary of all findings derived from the data presented in the preceding chapter. This chapter commences with a summary that highlights teachers' authentic experiences and their classroom practices. Each finding is interpreted with care and professionalism. The meticulous interpretation of these findings enabled the researcher to formulate suggestions based on the study's results, along with recommendations for future research endeavors. As the researcher, I collected data from Grade 7 mathematics teacher participants involved in the study. The data for this current research study were generated through semi-structured interviews and classroom observations. Thematic analysis was employed to interpret the data. The primary focus of these data generation instruments was to address the two research questions:

- What are the teachers' experiences in teaching Number Patterns to grade 7 learners in KwaZulu-Natal?
- In what ways do teachers' experiences influence their approaches to teaching Number Patterns in Grade 7?

6.2 SUMMARY OF THE STUDY

The focus of the study was to explore the experiences of the teachers in teaching Number Patterns. This research produced high-quality and dependable data from the four teacher participants, who were purposively chosen based on their years of experience in teaching mathematics in Grade 7. The qualitative research provided insight into the experiences of teacher participants as they selected appropriate methods, employed relevant approaches, and chose suitable strategies, along with the impact of these choices on the teaching and learning of Number Patterns for grade 7 learners. The teacher participants' strategy on their actual classroom practices and the effects of their experiences on learners' learning are unpacked as the summary of findings in the next section.

The teachers were able to create a classroom environment that supported social learning and the capacity of learners to cultivate their own knowledge and comprehension.

6.3 FINDINGS FROM THE RESEARCH

This section examines the themes that emanated from the responses of the teachers who participated in the study. Each theme contributed to a valuable and meaningful exploration of teachers' experiences in teaching Number Patterns to Grade 7 learners. The themes were formulated to respond to the two research questions. The outcomes of the study are discussed below.

6.3.1 Research Question 1: What are the teachers' experiences in teaching number patterns to grade seven learners in KwaZulu-Natal?

The teacher participants employed different methods that allowed them to assist learners in developing their own understanding. The approaches teachers used considered the needs of the learners in their classroom. Employing diverse approaches motivates teachers to foster a supportive atmosphere conducive to teaching and learning. Teachers encouraged critical thinking and problem-solving through the various techniques they utilised. In teaching Number Patterns to Grade 7 learners, it was essential for both teachers and learners to comprehend their educational needs and the necessary activities that could enhance learner development within the classroom. The Department of Basic Education in South Africa normally organises workshops for teachers teaching mathematics, suggests methods during these teacher workshops, but teachers must choose the relevant method based on their learners' needs.

The teacher participants used various strategies to encourage learners' active participation. The main strategy was class discussions. Learners were allowed to elaborate and justify their opinions during the discussions, thereby developing self-confidence in the discussions. Creating a classroom environment that supports learners' full participation was a huge challenge for both teachers and learners. The learner-centred approach was adopted by the teachers to reinforce the participation of learners in the lesson. Teacher-learner interaction in the class increased as the teacher participants used questions to engage the learners in the classroom. Learner-initiated discussions were encouraged by means of learners stating their challenges, which became a subject of discussion to enable learners to engage in the classroom. The teacher participants implemented

cooperative and collaborative learning strategies to facilitate teamwork among learners to accomplish tasks. Teachers promoted group work to help learners collaborate with one another, and through this interaction, learners gained knowledge from each other. The incorporation of cooperative and group work in the classroom aided learners in developing a shared understanding, enhanced retention capabilities, leadership skills, and teamwork abilities nurtured within the class. Group work was encouraged by the teachers to assist learners in collaborating with each other, and through that interaction, learners learnt from each other. Using cooperative and group work in class helped learners develop a common idea, high retention ability, leadership qualities, and teamwork skills fostered in the class. Teachers also allowed learners to discover themselves through social learning strategies. The teacher participants structured their lessons to accommodate the different abilities of learners, managing time properly, to ensure that the objective of the lesson is achieved within the teaching time.

The participants explained both the concepts in Number Patterns and the new concepts that were integrated from other aspects of mathematics to make the learning of Number Patterns much easier for the learners. Routine procedures and complex procedures were all explained in detail by the teachers to assist learners in comprehending the learning of Number Patterns. Learning was more flexible when the teacher explained details of all the terminologies involved in the teaching and learning of both numeric and geometric patterns. The learners build their listening skills through the explanations provided by the teachers during the lesson. Misconceptions of learners were cleared through the explanations of concepts by the teachers during the lesson. Teacher participants employed realistic mathematics activities and strategies to make learners understand the concept of generalisation in Number Patterns. Practical activities were also used in the classroom for learners to understand how the rules of patterns were generated. Inductive reasoning was used by teachers in providing a means for the learners to generalise patterns.

The teachers considered the use of concrete objects as a means of linking real-world experiences with the classroom experiences of learners on Number Patterns. The findings also indicated that learners were actively involved in the lesson when concrete objects were introduced into the lesson. The teachers used concrete objects to assist learners in discovering knowledge of new concepts. Using concrete objects, learners visualised and explored mathematical concepts. The

teachers used objects such as blocks, counting bars, and number tiles to identify, recognise, and extend pattern blocks. Matchsticks and wooden blocks were used by the teachers to assist learners in developing numeric patterns. Learners used these objects to create shapes, which helped the learners to identify the common change in Number Patterns.

The use of manipulatives in the lesson shows good classroom management and control by the teacher. Learners conceptualised the ideas in both numeric and geometric patterns through the engagement of manipulatives in the lesson. The teacher becomes a facilitator when using concrete manipulatives, allowing the learners to take charge of the lesson. The teachers agreed that the use of manipulatives in the classroom is challenging, but when managed properly during the lesson, they make things easier for the learners to understand. Evidence from the teachers shows that time management is vital when using manipulatives in the lesson. Using manipulatives demands the teachers' deep knowledge of content and the relevant method to choose for the lesson.

From the responses of the teachers in this study, it was clear that teachers used charts to explain complex concepts in Number Patterns as reinforcement. The utilisation of charts enhances the understanding of patterns and enables teachers to tailor lessons to meet the needs of learners in the classroom. Worksheets were designed by the teachers in the form of charts to build learners' ideas and develop their critical thinking skills. The use of charts helped the teachers to incorporate technology into the lesson and give learners an opportunity to visualise patterns. The effort of teachers towards the preparation of charts and proper lesson preparation was seen in the manner the lesson was structured.

The findings revealed that teachers assisted the learners to develop critical observation skills and determine a trend within any given sequence of numbers. Learners were taught by the teachers to identify the common change in some given patterns, guiding them to find the rules of the pattern. The use of mathematical equations was introduced by the teachers as an approach to help align the abilities of the learners through differentiated learning. The learners were given explanations on how to find the rules of any given pattern, using video presentations and collaborative activities in the classroom. Structured activities from the DBE mathematics workbook were assigned to learners to reinforce the skill of determining the common change in any specified patterns.

The incorporation of various concepts within the lesson assisted the learners in developing a better understanding of Number Patterns. The teachers incorporated concepts such as graphs, flow diagrams, exponents, basic operations, and basic counting principles. The responses from individual teachers indicated that incorporating additional concepts into the teaching of Number Patterns enhances learners' comprehension. The integration of other mathematical concepts in the lesson requires teachers to have a deep understanding of methods, along with effective time management in the classroom. Proper teaching methods were employed by the teachers to ensure that learners are not overwhelmed by the integration of other concepts. Learners develop better retention and the ability to relate ideas when the integration of concepts in Number Patterns is done properly.

The responses from the semi-structured interview showed that teachers used various approaches to help learners develop knowledge and understanding in the learning of Number Patterns. The approaches chosen by teachers during the lesson were based on the learners' needs and the level of methodological understanding of the teachers. The teachers used scaffolding, monitoring and shaping, facilitation, and explanation. These approaches adopted by teachers were built on their experiences in their classroom context.

The teacher participants used leading questions to assist learners in understanding the concepts learnt in Number Patterns. Complex tasks were broken down into smaller, manageable components by teachers through scaffolding and allowing the learners to take responsibility for their learning and develop their own knowledge. The teachers develop step-by-step routine procedures and, through leading questions, build their own understanding. Learners work with key ideas to navigate through the task given to learners during the lesson. Using scaffolding, teachers can incorporate multimedia resources such as video, podcasts, and simulations as alternative means of scaffolding. The teachers moved around the classroom during the scaffolding, making sure that learners followed the guidance given to them to achieve the intended result.

Teachers established a monitoring mechanism during the lesson, which enabled the learners to participate in the lesson fully. The learners were put in groups to allow the teachers to monitor the learners' behaviour during the lesson. Monitoring learners' work assists the teachers in evaluating

the learners' learning. Teachers used monitoring to raise the interest of learners to participate in the lesson and encourage learner-teacher interaction in the classroom. The teachers used the monitoring approach to identify the gaps learners had during the lesson. Learners are subsequently provided with guidance on how to enhance their comprehension of Number Patterns. Monitoring enhances the teachers' ability to give feedback on learners' questions and responses during the lesson. Learners pay more attention to their work when proper monitoring is done by the teacher.

The teacher participants encouraged the learners to develop their understanding while they took the position of facilitating the learning process. This role of facilitation allows the teachers to devise flexible means of coaching the learners during the lesson. The teachers established a classroom atmosphere that fostered learning and promoted collaboration among peers. The teachers, acting as facilitators, directed their attention towards the requirements of the learners. The teachers' role in facilitating the learning process was vital, restricting the classroom discussions to focus on the topic at that time. Generally, in facilitation, teachers rotate the learners during class discussions, making sure all learners take their turn.

Developing critical thinking skills during the teaching and learning of Number Patterns was enforced by the activities given to the learners during the lesson. Learners were requested to justify and analyse their responses. Teachers encouraged the learners to apply logical reasoning and mathematical reasoning in dealing with tasks during the learning of Number Patterns. The use of investigation and discovery learning developed the critical thinking ability of the learners during the lesson. Learners were requested to re-explain their responses and solve non-routine problems through collaborative learning in smaller groups. Practical real-world scenarios were created by the teachers to assist learners in developing critical thinking skills in the classroom, using concrete objects to generate more understanding and critically derive the concepts from the given objects to assist the learners in their comprehension.

6.3.2 Research Question 2: In what ways do teachers' experiences influence their approaches to teaching Number Patterns in Grade 7?

This section elaborates on the pedagogical experiences of the teacher participants and how it influenced the learning of Number Patterns. The teachers' experiences, built from their numerous years of teaching mathematics in Grade 7, were gathered from the practical observation of the

teachers during the lesson. The effective teaching methodology used by the teachers in their lessons was gained through professional workshops on content and methodology, and collaboration with other colleagues over the years of practice.

The setup of the classroom during the lesson contributed to the way the learners responded and participated in the lesson. The arrangement of learners in small groups with group leaders made it easier for the teacher to communicate with them. The walls of the classroom were adorned with mathematical symbols, fostering an environment rich in mathematics that influenced the learners to take charge of their own learning process. Some of the teachers made learners sit in pairs, which also promoted collaboration and shared learning in the class. Learners were free to express their opinions during the lesson, with all the teaching aids at the disposal of the learners. Concrete objects were brought to the classroom for illustration and to link the classroom experiences of learners with the real-world experience outside the classroom.

The teachers frequently responded to learners' questions and responses during the lesson. Feedback to learners was done through numerous teachers' explanations and illustrations. The interaction between the learners and the teachers made the learners develop trust and confidence during the lesson. Learners' ideas were guided and shaped during teachers' feedback. Teachers' feedback encouraged classroom discussions, and simplification of concepts was also done during the feedback session. Learners' interest was stimulated through flexible methods in which feedback was given to learners. Misconceptions and errors of learners were corrected by the teachers during feedback.

The teachers established a clear objective and aims during the preparation of the lesson. The teachers communicated the objectives, aims, and expectations clearly to the learners of what they had to achieve at the end of the lesson. The teachers incorporated other concepts into the lesson outside of Number Patterns. Concrete objects were introduced into the lesson, making the lesson practical. The teachers' experiences showed that they had in-depth knowledge of content and methodology, which showed up in their lesson preparation and presentation. The objectives and aims of the lesson were in accordance with the concepts as well as the curriculum requirements of the learners.

6.4. SUGGESTIONS BASED ON THE FINDINGS OF THE STUDY

In addressing the essential elements of the teachers' experiences in teaching Number Patterns to Grade 7 learners, the following suggestions were made:

- Due to the workload of teachers, I suggest that teachers should upgrade themselves to be mathematics subject specialists in the senior phase. This might help in decreasing the problem of choosing the right methodology to resolve the challenges learners face in any mathematics classroom. The choice of the right approaches for the benefit of all learners with different learning abilities was a challenge for mathematics teachers at the senior phase level.
- The teaching of Number Patterns is challenging due to the incorporation of additional concepts into lessons. I suggest that teachers should critically select relevant concepts that make the lesson much easier for both teachers and learners in the classroom.
- Due to the different school context and different backgrounds of teachers and learners they teach, I suggest that mathematics teachers should collaborate with each other, sharing ideas on content, approaches, and methodology. This will assist the teachers in adapting to best practices.
- I suggest that teachers should employ differentiated learning strategies to help learners understand the concept of number patterns, especially when dealing with geometric patterns and generalisation of patterns.
- Dealing with individual learners' challenges and creating a positive learning environment for mathematics teaching and learning, I suggest that teachers use more scaffolding activities to enhance the learners' active participation in class.

It is evident that the teaching and learning of Number Patterns in Grade 7 is crucial for their continuous mathematics education in the subsequent classes ahead.

6.5 IMPLICATION FOR FURTHER RESEARCH

This chapter concludes with a call for further research into the experiences of teachers regarding the teaching of Number Patterns across Grade 7 classes in all primary schools. The aim is to investigate how Number Patterns are taught in relation to various contextual factors throughout South Africa. This research would provide essential data on teachers' experiences in teaching Number Patterns at the Grade 7 Level. The further research study could focus on the following

aspects: teachers' approaches to teaching Number Patterns in Grade 7 in rural primary schools where learners have a poor background of mathematics exposure, how teachers' select the relevant methodology and activities for effective teaching of Number Patterns in Grade 7 are designed to accommodate the varied learning abilities of learners within a social classroom, as well as to incorporate digital learning tools in the teaching of Number Patterns to Grade 7 learners.

6.6 RECOMMENDATIONS FOR THIS RESEARCH

6.6.1 Recommendation 1

Seed and River, in their responses from the interview and during observations, indicated that learners are allowed to create their own patterns during the lesson. Some learners created patterns that were not aligned to the concept being discussed. These random patterns created inconsistency in the lesson delivery, leaving learners unattended. The use of unplanned activities by the teachers shifted the focus of the lesson.

It is recommended that activities for teaching and learning Number Patterns in Grade 7 should be formulated in line with a particular concept to be addressed during the lesson. The activities should be directed towards achieving the objective of the lesson. In this instance, the DoE or policy makers or curriculum developers can assist teachers by creating more standardised activities to cater to all cognitive levels in line with the lesson.

6.6.2. Recommendation 2

The teaching of geometric patterns was a challenge to the teachers in the sense that they did not have enough resources on solid figures for mathematical illustrations. The teachers utilised sketches that fail to depict all dimensions of the shape, making it challenging for students to connect the concepts being presented by the teachers to the shape within geometric patterns.

It is therefore recommended that policymakers and the DoE should provide mathematics teachers with solid geometric figures to assist teachers and learners in any lesson on geometric patterns.

6.6.3 Recommendation 3

The teacher-participants developed their worksheets for the learners, and this was not consistent with all teachers, but they were all teaching Number Patterns. This creates differences within the schools, and that also impacts the level of mathematics education that is provided to the learners. Some teachers did not have their own designed worksheet. They drew 3D shapes on the board and

some of the sketches were not up to the standard of those teachers who were able to design their worksheets.

It is recommended that DoE provide teachers with well-structured worksheets that would bring standardisation among mathematics teachers within all schools.

6.6.4 Recommendation 4

Learning Number Patterns in Grade 7 is challenging for the learners. Delta in his response stated that the integration of various concepts within Number Patterns contributes to the challenges learners face in understanding the concept of Number Patterns. Seed, River, and Ocean responded that learners must understand concepts such as functions, equations, and place values before understanding number patterns. The teachers are forced to complete the curriculum within the stipulated time given by the DoE. This makes it difficult for teachers to effectively simplify the concept for learners in Grade 7.

It is recommended that the DoE and policy makers spread the topic Number Patterns across all four terms of an academic year, so that smaller sections on Number Patterns could be taught for a deeper understanding.

6.6.5 Recommendation 5

Seed integrated technology (Digital learning tools) in his lesson, using animations to illustrate the process of pattern generation, which created the learners' interest in participation in the class. Geometric shapes were accurately illustrated in the lesson by projecting 3D objects for the learners to draw a concrete conclusion during generalisation. On the other hand, River, Delta, and Ocean did not have access to digital learning tools, which places their learners at a disadvantage. The lessons on geometric patterns were not adequately dealt with in the lesson.

It is recommended that DoE, in partnership with digital learning tools developers, should supply all primary schools with technological teaching and learning materials for mathematics learning at the primary school level.

6.6.6 Recommendation 6

It is recommended that the DoE ensure that all mathematics teachers at primary school have studied mathematics at high school and at the tertiary level. This assists in reducing the difficulties

that learners encounter in comprehending mathematical concepts. Teachers with a background in mathematics at both high school and tertiary levels are introduced to a variety of methods for teaching and learning mathematics, which provides a fundamental basis for classroom practices.

6.6.7 Recommendation 7

It is recommended that the Department of Education (DoE) and curriculum developers conduct workshops for teachers on pertinent concepts to incorporate into the teaching of Number Patterns at the primary school level. As teachers' experiences play a vital role in curriculum implementation, the right choice of concepts within mathematics and outside mathematics for integration into the teaching of Number Patterns is necessary at the senior phase, especially in Grade 7.

6.7 CONCLUSION

The teachers' experiences of teaching Number Patterns in Grade 7 at the Harry-Gwala district in KwaZulu-Natal indicated the impact of teachers in the teaching and learning process in the classroom. The promotion of social learning through interactive activities within the classroom suggests in-depth knowledge of content and methods that teachers have gained over years of practice, which impacts the learners' understanding. It is evident from the study that teachers' use of scaffolding, mediation, and collaboration strengthened the understanding and development of knowledge in mathematics. These approaches generally align with the constructivist theory, where learners develop their own knowledge through social interaction with their teachers and peers. The use of concrete objects, manipulatives, and digital learning tools in implementing the concept of Number Patterns shows the level of curriculum differentiation. In achieving the desired and intended objectives and aims of the lesson, teachers established supportive classroom settings that enable learners to develop the confidence necessary to engage fully in the teaching and learning of Number Patterns within the classroom. Considering the different contextual factors within which schools operate in the rural KwaZulu-Natal area, the study brought to light some of the best practices used during the teaching of Number Patterns in Grade 7.

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APPENDIX A: Approval Letter from the Department of Education



KWAZULU-NATAL PROVINCE

EDUCATION
REPUBLIC OF SOUTH AFRICA

OFFICE OF THE HEAD OF DEPARTMENT

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Tel: 033 392 1051

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Enquiries: Mrs B.T. Ntuli

Ref.:2/4/8/7503

Mr Emmanuel Bentum Djan
Private Bag X555
IXOPO
3276

Dear Mr DJAN

PERMISSION TO CONDUCT RESEARCH IN THE KZN DoE INSTITUTIONS

Your application to conduct research entitled: **"TEACHERS' EXPERIENCES OF TEACHING NUMBER PATTERNS TO GRADE 7 LEARNERS IN KWAZULU-NATAL."**, 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 **21st June 2023 to 31st December 2025**.
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 Mrs Buyi Ntuli at the contact numbers above.
9. Upon completion of the research, a brief summary of the findings, recommendations or a full report/dissertation/thesis must be submitted to the research office of the Department. Please address it to The Office of the HOD, Private Bag X9137, Pietermaritzburg, 3200.
10. Please note that your research and interviews will be limited to schools and institutions in KwaZulu-Natal Department of Education.


Mr GN Ngcobo
Head of Department: Education
Date: 21st June 2023

APPENDIX B: ETHICAL CLEARANCE LETTER FROM UKZN



17 August 2023

Emmanuel Bentum Djan (210550741)
School Of Education
Edgewood Campus

Dear EB Djan,

Protocol reference number: HSSREC/00005875/2023

Project title: Teachers' experiences of teaching number patterns to grade 7 learners in KwaZulu-Natal

Degree: Masters

Approval Notification – Expedited Application

This letter serves to notify you that your application received on 14 July 2023 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC) 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.

This approval is valid until 17 August 2024.

To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

HSSREC is registered with the South African National Health Research Ethics Council (REC-040414-040).

Yours sincerely,



Professor Dipane Hlalele (Chair)

/dd

APPENDIX C: Consent Letter to Participants

CONSENT TO PARTICIPATE IN A RESEARCH STUDY

TOPIC: Teachers' Experiences of Teaching Number Patterns to Grade 7 Learners in KwaZulu-Natal
Date:

Dear Sir/ Madam,

My name is Emmanuel Bentum Djan, a Master of Education Student from the University of KwaZulu-Natal, under the college of humanities at Edgewood campus. My student number is 210550741. My contact details are [REDACTED] and my email: [REDACTED]

You are being invited to consider participation in a study that involves research on Teachers' experiences of Teaching Number Pattern to Grade 7 Learners in KwaZulu-Natal. The aim and purpose of the research study is to explore the experiences of mathematics teachers at the primary level, on the teaching of number patterns in the mathematics curriculum. The study is expected to enroll five participants from randomly selected five primary schools within the district. It will involve the following procedure: interview and observation. The duration of your participation if you choose to enroll and remain in the study is expected to take three months. The study is funded by the researcher.

The study may involve the following discomfort of you having to accommodate me in your schedules on a particular day and sometime a schedule meeting outside your normal working hours at school. I hope the study will create a platform for primary school mathematics teachers to engage in teaching of number patterns from a different perspective, acquired from the different experiences of teachers. The study will serve to improve the methodology and the conceptual background of teachers teaching number patterns in primary schools. The study will seek to improve learners' ability to generalized patterns through teachers' experiences.

The study has been ethically reviewed and approved by the UKZN Humanities and Social Science Research Ethic Committee. In the event of any problems or concerns/questions you may contact me at [REDACTED] or the UKZN Humanities & Social Sciences Research Ethic Committee, contact details as follows:

HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION
Research office, Westville Campus
Goven Mbeki Building
Private Bag X54001
Durban
4000
KwaZulu-Natal, South Africa
Tel: 27312604557- Fax: 27312604609
Email: HSSREC@ukzn.ac.za

Participation in the research study is voluntary, and participants may withdraw from the study at any point of the study. The withdrawal or refusal of participant to continue in the study will NOT

incur penalty or loss of treatment or other benefits to which they normally entitled. Participants who wish to withdraw from the study can either do so; Telephonically, Verbally, or written consent, and upon which the participant will be withdrawn from the study. NO cost will be incurred by participants, and NO incentives will be given to participants during and after the study. NO personal information of participants will be printed anywhere on the research material, or the data generated by the researcher during the study. NO names of schools of participants and the information/data generated will not be used for any other purpose rather than the study, data will be stored by the researcher in a more secure storage system.

CONSENT BY PARTICIPANT

I ----- have been informed about the study entitled: Teachers' Experiences of Teaching Number Patterns to Grade 7 Learners in KwaZulu-Natal, by Emmanuel Bentum Djan.

I understand the purpose and procedures of the study; that is to explore the teachers' experiences of teaching number patterns in grade 7. The procedure which is interview and classroom teaching observation.

I have been given an opportunity to ask questions about the study and have had answers to my satisfaction.

I declare that my participation in this study is entirely voluntary and that I may withdraw at any time without affecting any of the benefits that I usually am entitled to.

If I have any further questions/concerns or queries related to the study, I understand that I may contact the researcher at [REDACTED]

If I have any questions or concerns about my rights as a study participant, or if I am concerned about an aspect of the study or the researcher then I may contact:

HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION

Research office, Westville Campus

Goven Mbeki Building

Private Bag X54001

Durban

4000

KwaZulu-Natal, South Africa.

Tel: 27312604557- Fax: 27312604609

Email: HSSREC@ukzn.ac.za

I hereby provide consent to:

Audio-record my interview for the research purpose: YES ☐ NO ☐

Audio-record my classroom lesson presentation: YES ☐ NO ☐

Signature of participant

Date

APPENDIX D: Interview Schedule

INTERVIEW SCHEDULE

Research Topic:

Teachers' Experiences of Teaching Number Patterns to Grade 7 Learners in KwaZulu-Natal

Grade: 7

BEFORE THE INTERVIEW

On meeting the participant, I will greet the participant and introduce myself to him/her and allow the participant to introduce himself/herself. After the introduction I will then remind the participant about the purpose of our meeting and discussions pertaining to the study and allowing the participant to ask questions before the interview starts. I will also ask the participant general questions such as his/her school culture and extra-curricular activities that learners do in the school, to make the participant feel relaxed before the actual interview.

- 1 What is your general understanding of the concept of number patterns?
- 2 In your teaching, how do you usually introduce the concept of number patterns to your grade 7 learners?
- 3 What are the teaching strategies used in your classroom during the teaching of number patterns?
- 4 What teaching aid do you use in teaching number patterns in your classroom?
- 5 In your experience of teaching number patterns to grade 7 learners, are they able to differentiate the various forms of number patterns? If not, how do you assist learners to differentiate between the various forms of number patterns in the classroom?
- 6 What are some positive and/or negative experiences of teaching number patterns in grade 7?

- 7 In your experience of teaching, how do you ensure that learners are able to use generalisation in number patterns?
- 8 What are the different concepts that you integrate into the teaching of number patterns in the class?
- 9 What strategies do you use in assisting learners to identify the various forms of number patterns?
- 10 In your experience, are learners able to relate the number patterns learnt in classroom to the real-life situation? To what extent?
- 11 What learner involvement strategies do you employ during the teaching of number patterns in the classroom?
- 12 In your teaching of number patterns, how do you promote learners' critical thinking skills in grade 7?
- 13 So, can you say that the way you teach number patterns to grade 7 learners is effective? In what way?
- 14 In a case where your teaching of number patterns is not effective; what do you normally do to implement improvement in the classroom?

APPENDIX E: Observation Schedule

OBSERVATION SCHEDULE

Research Topic:

Teachers' Experiences of Teaching Number Patterns to Grade 7 Learners in KwaZulu-Natal

Subject: Mathematics

Date:

Lesson Topic: Number Patterns

Grade: 7

BEFORE THE OBSERVATION

In meeting the participant, I will greet him/her and start a general conversation on the readiness of the learners for the lesson and his/her readiness for me to observe.

LESSON ASPECTS TO OBSERVE	OBSERVED PRACTICE
1. SUBJECT MATTER CONTENT (shows good command and knowledge of the subject matter; demonstrate breadth and depth of mastery)	
2. ORGANISATION (organises subject matter; evidence of preparation; emphasises and summarised main points; meets class at schedule time; regularly monitors learners work)	
3. RAPPORT (holds interest of learners; is respectful, fair, and impartial; provides feedback; encourages participation; interact with learners, shows enthusiasm)	

4. TEACHING METHODS (use relevant teaching methods, aids, materials, techniques, and technology; includes variety, balance, imagination, group involvement; uses examples that are simple, clear, precise, and appropriate; stays focused and meet stated objectives)	
5. PRESENTATION (establishes classroom environment conducive to learning; maintains eye contact; uses a clear voice, strong projection)	
6. MANAGEMENT (uses time wisely; demonstrates leadership ability; maintains discipline and control)	
7. SENSITIVITY (exhibits sensitivity to learners' personal culture, gender differences and disabilities, responds appropriately in a non-threatening, pro-active learning environment)	
8. ASSISTANCE TO LEARNERS (assist learners with academic problems)	
9. PERSONAL (evidence of self-confidence; maintains professional comportment and appearance)	
10. PHYSICAL ASPECTS OF THE CLASSROOM (layout of room, distractions if any; list any observations of how physical aspects affected content delivery)	

APPENDIX F: Approval Letter from Principal (School A)

Please address all correspondence to the Principal

24 April 2023

Mr. E. B Djan
P. bag x555
Ixopo
3276

Dear Mr. Djan

Permission To Conduct Research In

Your application to conduct a research on the topic Teachers' Experiences of teaching number patterns to grade 7 learners in Kwazulu-Natal, has been granted.

Hoping that you will get the assistance you need from teachers.
Thank you.

Yours Sincerely

APPENDIX G: Approval Letter from Principal (School B)

20 June 2023

TO WHOM IT MAY CONCERN

**RE: PERMISSION TO CONDUCT A RESEARCH STUDY FOR GRADE 7
MATHEMATICS**

This letter serves to permit *Djan Emmanuel Bentum* student number *210550741* to conduct a research study for grade 7 mathematics at the above-mentioned school. He will start his research as soon as he wishes, preferable from the beginning of term 3 2023 up until he finishes his research with grade 7 mathematics teacher.

We wish him an enjoyable study and research in our institution and receive all required points from your institution, we thank you.

Yours faithfully

APPENDIX H: Approval Letter from Principal (School C)

23 June 2023

Mr E.B.Djan

PERMISSION TO CONDUCT RESEARCH

Consent to conduct research : "Teachers' Experiences of Teaching Number Patterns to Grade 7 Learners in KwaZulu Natal has been approved .

Yours In Education

APPENDIX I: Approval Letter from Principal (School D)

To Whom It May Concern

Dear Sir

This letter serves to inform you that Mr Emmanuel Bentum Djan the Deputy Principal of Ixopo Primary is allowed to conduct his research to grade 7 Teachers at [REDACTED]

Yours in education

APPENDIX J: Approval Letter from Principal (School E)

23 June 2023

Dear Sir

This is to confirm that the school mentioned above has permitted Mr. E.B. Djan to conduct research in the school with our Grade 7 Mathematics educator next term.

Hope and wish he will get all the information needed in his research.

Yours Sincerely

APPENDIX K: Letter from Editor



Prof Jabulani Sibanda
Associate Professor: Academic Literacies and English Teaching
Department of Secondary and Post-School Education
Faculty of Education
Education Department, Grey Street, Grahamstown/Makhanda, 6139, South Africa
PO Box 94, Grahamstown/Makhanda, 6140, South Africa
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c: +27 (0) [REDACTED]

www.rhodes.ac.za

LANGUAGE EDITING CERTIFICATE

LANGUAGE EDITING DECLARATION

I confirm that I have proofread and edited the Dissertation detailed below, using the Windows 'Tracking' System to reflect my comments and suggested corrections for the author(s) to action.

DETAILS OF WORK COMPLETED

Language Editing
Document Type: Dissertation
Title: Teachers' Experiences of Teaching Number Patterns to Grade 7 Learners in Kwazulu-Natal

CLIENT'S DETAILS

Author: Djan Emmanuel Bentum
Affiliation: University of KwaZulu-Natal
Student No: 210550741

EDITOR'S DETAILS

Prof Jabulani Sibanda
PhD English Education
SARS Tax number [REDACTED]

Although the greatest care was taken in editing this document, the final responsibility for the product rests with the author(s).

SIGNATURE

[REDACTED]

DATE

07.05.2025

This certificate confirms the language editing I have done in a personal capacity and not on behalf of Rhodes University.

APPENDIX L: Turnitin Report

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