

Teacher experiences in teaching number sense in the Foundation Phase

by

Scholastica Maletsose Mamogale

(95179578)

Submitted in partial fulfilment of the requirement for the degree

MAGISTER EDUCATIONIS

in the

Department of Education

at the

University of Pretoria

Supervisor: Dr. R. Venketsamy

October 2019

DECLARATION


I, Scholastica Maletsose Mamogale, hereby declare that this M. Ed dissertation: ***Teacher experiences in teaching number sense in the Foundation phase*** is my original work and that all the sources I have consulted have been acknowledged.

Signature

Date

LETTER FROM LANGUAGE EDITOR

Dr C.G.A. SMITH

PhD (English) 

Language practitioner: editing and proofreading

Cell: 0727661428

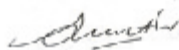
This is to certify that the following document has been language edited:

Teachers' experiences in teaching number sense in Foundation Phase

Authors: by Scholastica Maletsose Mamogale

Nature of document: A dissertation

Date of this statement: 3 October 2019



Smitkega

DEDICATION

I dedicate this research to my husband and three sons. My father and late mother who has been interceding for my success. My mother used to say “*A di go tsogele Mokwena*” – meaning, do your best child.

ACKNOWLEDGEMENTS

I wish to thank the following people:

- The omnipotent, Father in Heaven for the graces I have received in the journey of writing this study to the end;
- My supervisor, Dr Roy Venketsamy who supported me in my academic journey. Thank you for your advice, guidance, patience and encouragement. Without your support and guidance, this challenging degree would not have been possible. You are the best.
- My husband, Lance for allowing me space to study while you attended to family matters, most of all preparing meals for us.
- My dearest sons, Tshimologo, Tshenolo and Pako-Phenyo for viewing me as your inspiration.
- My daughter-in-law, Lethabo, for guiding me on how to transcribe data collected from interviews.
- My parents, father Nyatso and late mother, Magdeline, Matshwenyane who always supported me in this endeavour, I am grateful and honoured to be your daughter.
- Dr Corle Smit, my editor, your prompt response when I needed your services, the emojis you shared were amazing and amusing. Our professional relationship is appreciated;

I give sincere thanks to the participants, teachers whom I could not have completed this work without their active role to my research project.

ABSTRACT

This study was conducted in Gauteng Province and Tshwane North District. The study explored the poor performance of learners in Mathematics in the early grades. Learners' performance is dependent on teacher input in class. Learners' Mathematics performance is also influenced by various aspects contributing towards development such as nutrition, parental literacy which includes teachers' knowledge of content and language in the subject taught. The poor Mathematics performance is exacerbated by lack of visual perceptual skills as the basis for learning. This study sought to investigate whether early grade teachers met this requirement. The proposed research investigated the teaching of number sense in the early grades. The research was informed by daily experience as subject advisor.

The study was informed by theories of both Vygotsky and Piaget. Teaching in the Foundation Phase is mainly through group work and play and therefore this theory is appropriate. The primary research question for this study was as follows: How do teachers experience teaching number sense in the Foundation Phase? Data were collected using semi-structured interviews and observation. Purposive sampling was used to select participants for this study. Teachers from Grades 1-3 were interviewed and it was found that many lacked content knowledge and different strategies to teach number sense. Furthermore, teachers indicated that there was minimal support from HODs and subject advisors. They agreed that they needed more capacity building workshops to strengthen their knowledge and understanding of teaching number sense.

The study revealed that teachers teach Mathematics in Foundation Phase without the relevant qualification. Due to the lack of knowledge and understanding of the Foundation Phase content, strategies and methods of teaching, teachers experienced challenges mainly in teaching number sense in the early grades.

KEY TERMS

Number sense, Foundation Phase, Learning and teaching, Experiences and Constructivism.

TABLE OF CONTENTS

DECLARATION	i
LETTER FROM LANGUAGE EDITOR	ii
DEDICATION	iii
ACKNOWLEDGEMENTS	iv
ABSTRACT	v
KEY TERMS	v
TABLE OF CONTENTS	vi
LIST OF TABLES	xii
LIST OF FIGURES	xiii
LIST OF ABBREVIATIONS	xiv
1. CHAPTER 1: INTRODUCTION AND ORIENTATION	1
1.1 INTRODUCTION.....	1
1.2 RATIONALE.....	3
1.3 PROBLEM STATEMENT	4
1.3.1 Primary question	5
1.3.2 Secondary questions.....	5
1.4 CONCEPT CLARIFICATION	5
1.4.1 Number sense.....	5
1.4.2 Experience	6
1.4.3 Foundation Phase	6
1.4.4 Teaching	6
1.5 LITERATURE REVIEW.....	7
1.5.1 Introduction	7
1.5.2 Importance of teacher in a number sense lesson.....	7
1.5.3 Teachers' support	8
1.6 THEORETICAL PERSPECTIVES.....	9
1.7 RESEARCH METHODOLOGY	12
1.7.1 Research design	12
1.7.2 An interpretivist paradigm.....	13
1.7.3 Qualitative research approach	13
1.7.4 Research type	14
1.7.5 Research methods.....	14

1.7.5.1	The role of the researcher	14
1.7.5.2	Participants and research site	15
1.7.6	Data collection.....	15
1.7.6.1	Interviews	15
1.7.6.2	Observations	16
1.7.6.3	Sampling	16
1.7.7	Document analysis.....	16
1.8	DATA ANALYSIS	17
1.9	TRUSTWORTHINESS	17
1.9.1	Credibility	17
1.9.2	Dependability	18
1.9.3	Confirmability	18
1.9.4	Transferability.....	18
1.10	ETHICAL CONSIDERATIONS.....	18
1.10.1	Ethical clearance.....	19
1.10.2	Informed consent	19
1.10.3	Anonymity and confidentiality.....	19
1.11	CONCLUSION	19
2.	CHAPTER 2: LITERATURE REVIEW.....	20
2.1	INTRODUCTION.....	20
2.2	THEORETICAL FRAMEWORK: CONSTRUCTIVIST THEORY	20
2.3	BACKGROUND TO TEACHING MATHEMATICS IN EARLY CHILDHOOD EDUCATION.....	23
2.4	AN EXPLANATION OF NUMBER SENSE.....	25
2.5	THE IMPORTANCE OF NUMBER SENSE TO MATHEMATICS ACHIEVEMENT IN THE FOUNDATION PHASE.....	27
2.6	CHALLENGES EXPERIENCED BY TEACHERS TEACHING NUMBER SENSE IN THE FOUNDATION PHASE	31
2.6.1	Teacher content and pedagogical knowledge	32
2.6.2	Teacher training and development.....	35
2.6.2.1	Time and the well-planned environment	37
2.6.2.2	Relevant resources and number lines	38
2.6.2.3	Teacher qualifications	38

2.6.2.4	Teacher support from School Management Team and Districts subject advisors.....	39
2.6.2.5	Class size.....	39
2.7	STRATEGIES TO TEACHING NUMBER SENSE IN THE FOUNDATION PHASE.....	39
2.7.1	Teaching of number, operations and relationships as a content area ...	39
2.7.2	Counting all	42
2.7.3	Counting on.....	43
2.7.4	The Number line.....	44
2.7.5	Addition and subtraction as inverse operations.....	45
2.7.6	Place value.....	45
2.8	IMPORTANCE OF A CONDUCTIVE MATHEMATICAL ENVIRONMENT IN THE FOUNDATION PHASE.....	46
2.8.1	Availability of resources	46
2.9	CONCLUSION	47
3.	CHAPTER 3: METHODOLOGY	48
3.1	INTRODUCTION.....	48
3.2	RESEARCH DESIGN	48
3.2.1	An interpretivist paradigm.....	49
3.3	QUALITATIVE RESEARCH APPROACH.....	50
3.3.1	Research type: Multiple case study.....	51
3.4	RESEARCH METHODS	52
3.4.1	Research site and participants	52
3.4.1.1	Research site	52
3.4.1.2	The selection of participants.....	52
3.4.1.3	Sampling criteria for participants	55
3.5	THE ROLE OF THE RESEARCHER	55
3.6	DATA COLLECTION.....	56
3.6.1	Data analysis.....	56
3.6.2	Limitations	57
3.6.2.1	Trustworthiness.....	59
3.6.2.2	Credibility	60
3.6.2.3	Transferability.....	60

3.6.2.4	Dependability	60
3.6.2.5	Confirmability	60
3.6.2.6	Triangulation	61
3.7	ETHICAL CONSIDERATIONS.....	62
3.7.1	Ethical clearance.....	62
3.7.2	Informed consent	62
3.7.3	Anonymity and confidentiality.....	63
3.8	SUMMARY	63
4.	CHAPTER 4: DATA ANALYSIS AND RESULTS	64
4.1	INTRODUCTION.....	64
4.1.1	Primary question	64
4.1.2	Secondary questions:.....	64
4.2	RESEARCH SETTING AND PARTICIPANTS	65
4.3	DESCRIPTION OF THE SEMI-STRUCTURED INTERVIEWS.....	66
4.3.1	Profile of participants.....	67
4.3.1.1	Teacher 1	67
4.3.1.2	Teacher 2.....	67
4.3.1.3	Teacher 3.....	67
4.3.1.4	Teacher 4.....	68
4.3.1.5	Teacher 5.....	68
4.3.1.6	Teacher 6.....	68
4.4	DATA ANALYSIS PROCESS.....	69
4.5	RESEARCH RESULTS.....	69
4.5.1	Theme 1: Teachers understanding of the concept “number sense”	71
4.5.1.1	Knowledge and understanding of number sense	71
4.5.1.2	Teachers’ perceptions towards teaching and learning	74
4.5.2	Theme 2: Teachers’ experiences in teaching number sense	76
4.5.2.1	Planning and preparation for teaching and learning of number sense ..	77
4.5.2.2	Implementing CAPS as a guiding policy	80
4.5.2.3	Strategies, techniques and methods in teaching number sense	82
4.5.2.4	Differentiated teaching in the Foundation Phase.....	84
4.5.3	Theme 3: Challenges experienced by teachers in teaching number sense	86

4.5.3.1	Inadequate support, guidance and training	86
4.5.3.2	Inability to access and interpret policy documents	88
4.5.3.3	Usage of resources	89
4.6	CONCLUSION	96
5.	CHAPTER 5: INTERPRETATION OF RESEARCH FINDINGS, CONCLUSIONS AND RECOMMENDATIONS.....	97
5.1	INTRODUCTION.....	97
5.1.1	Primary question	97
5.1.2	Secondary questions:.....	98
5.2	THEMES AND SUB-THEMES EMERGING FROM THE DATA ANALYSIS.....	98
5.3	INTERPRETATION OF RESEARCH FINDINGS	108
5.3.1	Knowledge of number sense through basic perceptual skills	108
5.3.1.1	Knowledge of number sense and understanding of concept “number sense”	108
5.3.1.2	Teachers’ perception towards teaching and learning of number sense	109
5.4	TEACHERS’ EXPERIENCES IN TEACHING NUMBER SENSE.....	109
5.4.1	Planning and preparation for teaching and learning.....	109
5.4.2	Understanding the usage of CAPS as a guiding policy	110
5.4.3	Strategies, techniques and methods in teaching number sense	110
5.4.4	Differentiated teaching in the Foundation Phase.....	110
5.5	THEME 3: CHALLENGES EXPERIENCED BY TEACHERS IN TEACHING NUMBER SENSE	111
5.5.1	Support, guidance and training of teachers from Departmental Heads, School management Teams and District Officials.....	111
5.5.2	Inability to access and interpret the policy document (CAPS).....	111
5.5.3	Usage of resources during teaching and learning of number sense ...	112
5.6	THE EFFICACY OF THE THEORETICAL FRAMEWORK TO THE RESEARCH FINDINGS	112
5.7	LIMITATIONS.....	113
5.8	RECOMMENDATIONS.....	113
5.8.1	Teachers’ understanding of the concept “number sense” through perceptual skills.....	113

5.8.2	Teachers' experiences in teaching number sense in the Foundation Phase	113
5.8.3	Continuous professional development for Foundation Phase teachers to capacitate them in teaching number sense	114
5.9	CONCLUSIONS	115
6.	REFERENCE LIST	117
7.	APPENDICES	129
7.1	Appendix A: Clearance certificate	129
7.2	Appendix B: Ethics statement	130
7.3	Appendix C: Letter of consent University of Pretoria	131
7.4	APPENDIX D: Agreement to participate in educational research.....	132
7.5	APPENDIX E: Permission for research	134
7.6	APPENDIX F: Parents informed consent form	135
7.7	APPENDIX G: Request for permission to conduct research from the Principal	136
7.8	ANNEXURE H: Request for permission to conduct research from the Department of Basic Education.....	137
7.9	ANNEXURE I: Interview questions for the Focus Group Interview.....	138

LIST OF TABLES

Table 2.1: Weighting of the content areas.....	28
Table 3.1: Demographics of participating teachers	54
Table 3.2: Depiction of criteria for trustworthiness in qualitative research applied in the study.....	59
Table 4.1: Coding of participants.....	70
Table 4.2: Identified themes from the data collected.....	70
Table 4.3: Three levels in the Foundation Phase.....	90
Table 4.4: Depicts the teachers' knowledge and understanding of number sense within CAPS.....	94
Table 5.1: Summary and recommendations	99

LIST OF FIGURES

Figure 1.1: Zone of Proximal Development (Source: McLeod, 2019)	11
Figure 1.2: Learning is cognitive development (Source: McLeod, 2019)	11
Figure 2.1: Vygotsky's ZPD: (Syafiza, 2017).....	22
Figure 2.2: Image of Mathematics integration in everyday life (2019).....	22
Figure 2.3: Allocation of time towards lessons for Grades 1 to 3 for number sense (Source: DBE, 2011)	30
Figure 2.4: The strands of mathematical proficiency (Kilpatrick, 2001).....	31
Figure 2.5: Subitising according to colours adapted from Maths for Success (Source: Swan, 2019)	43
Figure 2.6: An example of counting on as strategy (Source: Shelley Grey teaching)	43
Figure 2.7: The effectiveness of the number line using groups of ten (Source: Maths resources)	44
Figure 2.8: Double number line depicting the basic grouping strategy (Source: Maths resources)	44
Figure 2.9: Representations of place value (Maths resources).....	46
Figure 3.1: Semi-structured qualitative studies (Source: Blandford (2013).....	57
Figure 3.2: The data analysis adapted process (Source: McMillan & Schumacher, 2010) and Creswell (2008)	58
Figure 3.3: Clarification on what triangulation (2016).....	62
Figure 4.1: Taken form teachers content workshop on: Content Area no. 1 - Number Operations and Relationships	74
Figure 4.2: The importance of preparation for teaching number sense (Source: Roberts, 2016)	79
Figure 5.1: Strategies relating to the counting and development of higher thinking skills (Swan, 2019).....	108

LIST OF ABBREVIATIONS

ACE	Advance Certificate in Education
ANA	Annual National Assessment
ANS	Approximate Number Sense
ATPs	Annual Teaching Plans
CAPS	Curriculum and Policy Statement
DBE	Department of Basic Education
DH	Departmental Head
DoE	Department of Education
ENS	Exact Number Sense
ECD	Early Childhood Development
FET	Further Education and Training
GPLMS	Gauteng Province Language and Mathematics Strategy
HE	Higher Education
HEI	Higher Education Institutions
LoLT	Language of Learning and Teaching
MKO	More knowledgeable One
PIRLS	Progress in Reading Literacy Study
SMT	School Management Team
SPTD	Senior Primary Teachers Diploma
TIMSS	Trends in Mathematics and Science Studies
ZPD	Zone of Proximal Development

1. CHAPTER 1: INTRODUCTION AND ORIENTATION

1.1 INTRODUCTION

The poor learner Mathematics performance, highlighted by the high failure rate, has surfaced as a salient challenge in South Africa in accordance with Taylor (2013). This trend of poor Maths performance is not exclusive to South Africa as this problem also materialises in other countries internationally and in Africa. Most learners are challenged with an “in-depth” understanding of number concept due to various factors. Venkat and Spaul (2015) found that the strategies used by teachers are a challenge in the early grades. This study aimed to look at teachers’ experience in South Africa, concerning the teaching strategies of number sense in the early grades. It envisaged to provide support to teachers to improve the quality of teaching and learning of number sense in the early grades. This qualitative study included teachers who taught learners in the Foundation Phase and endeavoured to share their experiences in teaching numbers sense in the early grades. The findings and strategies arrived at in this study will be shared with teachers in Gauteng Province to improve the teaching of number sense in the early grades.

The DBE (2011) defines Mathematics as a language that clarifies the basic calculations in Mathematics as a subject. It involves the relationships of both physical and social phenomena and relationships between mathematical objects. The symbols and notations described basic processes and their relationships. Humans use Mathematics as an activity that involves observing, representing and investigating patterns and qualitative relationships. Mathematics is a process that involves logical and critical thinking, accuracy and problem solving that will contribute to decision-making. Naudé and Meier (2014) contend that Mathematics is a story of how people organise their everyday lives to make sense of what is going on around them. In the early grades learning and teaching, Haylock (2010) points out that for learners to learn and understand Mathematics, it requires a teacher who understands the curriculum and is able to explain the content and concepts to the learners.

The question is: Do teachers know that Mathematics is everywhere? Are they aware that what is taught in early grades forms the basis for all learning of Mathematics

throughout the school years? Singh (2019) explains that learner development does not happen on its own, since it needs to be explored with planned activities to involve all senses and spheres of development. Brey (2016) elaborates that taking development to its highest level, teaching must have purpose, structure and process. It is an indication that preparation for teaching is imperative for learners to achieve as expected by all stakeholders.

Despite the vast knowledge of the teaching of Mathematics that is available and used to design creative learning activities, non-attainment of mathematical skills is an alarmingly pervasive feature at all levels indicated by Silver (1998) exposes the poor study results of both younger and older students and indicates that the poor performance in secondary school Mathematics emanates from the ineffectual learning foundations in early-grade mathematics. Martin and Mullis (2013) further indicates that in Grade 4, most learners already lag behind and the deficit becomes worse in the subsequent grades. Popovic and Lederman (2015) continue stating that there is significant underperformance in education, particularly in Mathematics teaching and learning. The coherence and connections expected in learning and teaching are invisible as indicated by Venkat and Adler (2012). The aforementioned authors indicate that there is a dire need for all stakeholders to regroup and have conversations on teacher development processes.

According to Lin and Tsao (2012) the failure rate that is experienced in the countries participating in the international assessments has impacted negatively on teachers' self-esteem in the early grades. The low self-esteem and uncertainty amongst early-grade teachers has bred fear of teaching Mathematics. Brian (2012) refers to this fear as "maths anxiety", a phenomenon that was first identified in the 1950s and its devastating effects on performance are now becoming evident.

Beaver, Jackman and Wyatt (2009) state that while teachers are normally good at specifying their short-term objectives, it may be an indication that they may be failing to properly plan for the long term. However, in South Africa, comprehensively Askew (2012) indicates that the curriculum is chased to be covered as per Annual Teaching Plans and quality of content is compromised.

1.2 RATIONALE

The proposed research investigated the teaching of number sense in the early grades. Trends in International Mathematics and Science Studies TIMSS (2015) informed the need to investigate the teaching of number sense in the identified early grades. This research is informed by the researcher's daily experiences as a subject advisor. DBE: CAPS (2011) states that topics such as "counting" starts in Grade R (5-6 in age) and continue in progression to Grade 12. Counting is a component, which has to be taught on daily basis to reinforce number sense in the process of learning and teaching. The researcher as a subject advisor, interacts with both learners and teachers on daily basis.

Performance in Mathematics is very poor TIMSS (2015) and new steps must be taken to work towards improvement. Moreover, Venkat and Spaul (2015) assert that teachers are struggling with content knowledge in primary Mathematics. In the researcher's experience, as a subject advisor and supporting teachers in classrooms, new concepts to learners are introduced without evidence of lesson preparation and concrete objects to elucidate content taught. Brey (2016) contends that low performance is exacerbated by lack of visual perceptual skills as the basis for learning. Perceptual skills are very imperative to find the understanding and knowledge of a concept. Yang, Hong and McBride (2019) substantiate that both visual spatial and memory skills are very important aspects of learning mathematics for young children. Perceptual skills have to be closely developed for learners to achieve in Mathematics.

In conversation with teachers, some do teach in Foundation Phase without the relevant qualification. Due to the lack of knowledge and understanding of the Foundation Phase content, strategies and methods of teaching, they experience challenges. It is noticed that teachers are challenged mainly in teaching number sense in the early grades. Andrews and Sayers (2015) indicate that there are two levels of number sense namely "foundational" and "applied" number sense. They further explain that foundational number sense involves the understanding of the interrelatedness of numbers that are learnt in class and much earlier before formal schooling. That encompasses the understanding and the relationship of numbers in a holistic manner which influences problem solving in everyday life situations.

Spaull (2015) points out, that children may be in school, but most are simply not learning as they should. Teacher content knowledge is at the helm of what is being done in class with the learners. Mathematics in the early grades should be practised and taught, as indicated and instructed by the DBE (2011). Naudé and Meier (2014) state that an environment that is conducive to meaningful learning is important. Focused teaching with well-planned lessons, especially on number sense, in the early grades will make a difference.

Jackman (2012) points out the importance of understanding that the acquisition of Maths skills and concepts occurs in developmental stages over time. It is the responsibility of the teachers to recognise that early Maths instruction and experiences are not limited or specific to a time of the day; the teacher should understand that opportunities to teach Maths are a natural part of the learning environment in an integrated curriculum (CAPS, 2011).

Jackman (2012) mentions that when teaching early grades, repetition is important. It reinforces the correct use of mathematical language. Young learners attempt to name things they use, and that gives the teacher the opportunity to correct and applaud learners where necessary. Providing a conducive environment, both indoors and outdoors, for early-grade learners to explore, should give them an opportunity to experience and explore the world as well as their personal space and encourage them to see and understand that learning and applying Mathematics are not limited to the classroom environment.

1.3 PROBLEM STATEMENT

The literature review is driven by the well-documented poor performance of learners in Mathematics in the early grades. Spaull (2015) indicated that South African learners have demonstrated poor Mathematics results and levels of performance and attainment. Poor study results of both younger and older students clearly indicate that the poor performance in secondary school Mathematics is due to weak learning foundations in early-grade numeracy (Burns, 2007) which raises questions about teachers' understanding of the content. He found that when learners enter Grade 4, most of the damage has already been done, which means that the problem lies in Grades R to 3 (the Foundation Phase). According to Graven and Venkat

(2017), the teacher quickly and instinctively translates their own mathematical knowledge into a form that matches the learners' level of knowledge at that moment. This study seeks to investigate whether early-grade teachers meet this requirement.

1.3.1 Primary question

- How do teachers experience the teaching of number sense in the Foundation Phase?

1.3.2 Secondary questions

- What strategies and methods do Foundation Phase teachers use to teach number sense in the early grades?
- What kind of support do teachers receive to strengthen their teaching of number sense in Foundation Phase?

1.4 CONCEPT CLARIFICATION

Concepts are clarified next.

1.4.1 Number sense

According to van de Walle, Karp and Williams (2015) number sense is described as a person's ability to use and understand numbers by knowing their relative values. There are ways of using them to make judgments. They are used in a flexible manner when applying four basic operations and how to develop useful strategies in counting, measuring and estimating.

Devlin (2017) defines number sense as a person's ability to use and understand numbers by knowing their relative values and how to use them to make judgments. Furthermore, it deals with how to use them in flexible ways when adding, subtracting, multiplying or dividing and how to develop useful strategies when counting, measuring or estimating. Shumway (2011) refers to number sense as a complex phenomenon. She says it is multi-layered. However according to her, it facilitates problem solving, reasoning and allows discussions around mathematical ideas. It is when the learner displays a strong sense of numbers when applying mathematical strategies.

Strong number sense is seen in the learners' ability to recognise quantity of a numbers. The learners should know that there are other numbers within the given number. An example is when the learner is able to know that in 4 there is 3, 2 and 1. One can add 3 and 1, 2 and 2 and still understand that they make 4. The learner with a strong number sense is able to connect a number and object and show understanding of the connection and how they correspond (Singh, 2019).

According to the DBE (2011) the development of number sense embraces the meaning of different kinds of numbers, how numbers relate, the relative size of numbers, and representation of numbers in various ways and the effect of operating with numbers. Numbers sense entails the understanding of how numbers work and are applied in the ways that the authors indicated with the aim of making the users understand and apply them in every situation.

1.4.2 Experience

The Collins English dictionary explains experience as “the process of getting knowledge or skill from doing, seeing, or feeling things.” Experience is further explained as an event or occurrence that is happening to you, or that you feel.

1.4.3 Foundation Phase

According to the Kirsten (2017) early childhood development is defined as a comprehensive programme for children aged 0-9 years, with a specific focus on children from 0-4 years, and Grade R 5-6 years. However, when we look at how the Foundation phase classes are categorised in schools, they also include grades R-3 which are considered to be the Foundation Phase. The Foundation Phase is part of early childhood development as per DBE definition. Learners aged 7 are in Grade 1, aged 8 in Grade 2 and aged 9 are in Grade 3 categorically. The definition translates to early grades as it encompasses Grade R-3 in Foundation Phase. According to DBE (2001) these children are between the years of 0-9 which is referred to as the early grades and the Foundation Phase.

1.4.4 Teaching

In education, teaching is the concerted sharing of knowledge and experience, which is usually organised within a discipline and, more generally, the provision of stimulus

to the psychological and intellectual growth of a person by another person or artefact.

1.5 LITERATURE REVIEW

The literature review follows next.

1.5.1 Introduction

This work was based on the experiences of teachers who teach Mathematics in the Foundation Phase. The focal point of the study was particularly on the teaching experiences of number sense. The study sought to see either the effectiveness or the ineffectiveness of teachers' experiences in teaching number sense in the Foundation Phase. The study was prompted by the low performance experienced throughout South Africa. South Africa is mentioned, but it is not a unique challenge to South Africa per se. The focus, however, remained on the South African context.

1.5.2 Importance of teacher in a number sense lesson

Briand-Newman, Wong and Evans (2012) refer to a teacher who said that young learners come to school and are already able to count yet, they count without knowing why they are counting. Learners need to develop a relational understanding where they will understand why two comes after one, and it is the teacher's responsibility to enhance the expected understanding of number sense. The understanding of why numbers have a sequence is amongst the duties that the teacher should perform. Learners must benefit to the utmost in the learning process. The learning environment should be well prepared. It should be prepared with relevant resources, which provide further opportunity to explore what is around them and relating to number sense.

A prepared learning environment is not only physical according to Singh (2019). Learners need the comfort of furniture, and a hazard-free and safe environment. They make sense when they experience some discipline, since there are rules that also protect them. Singh (2019) continue referring to rules and the consequences thereof as part of the environment.

There are resources to teach Mathematics in our environments Naudé & Meier (2014). They encounter both indoor and outdoor environments, and should be able

to see things that they can learn. The charts that are displayed against the walls in the classroom, must guide learners to make sense of length and measurement in general. There are trees that can be counted. Seeds can be used to count and make groups as required in learning.

The learners might identify all the mentioned items that can be used as resources to learn Mathematics in the Foundation Phase. Everything depends on the creativity that is expected that the teacher should possess. The teacher should not be stereotyped and only use props that are purchased. The example is much suitable in the rural areas where teachers usually allege that there are no resources in their classes. Graven and Venkat (2017) address the issue of resources in learning and teaching and indicate that teachers themselves are first resources. Content knowledge expected of teachers makes the professional development imperative to close the gap in learning and teaching to address non-attainment in schools.

1.5.3 Teachers' support

There is an expectation from teachers to be offered support. The support expected is despite the experience they have in the teaching of number sense in the Foundation Phase. The process of teaching and learning is adjusted every now and then through the teacher development units within the department. Departmental support enhances teacher knowledge needed to prepare for learning to take place. In the Foundation Phase, there is learning that is happening incidentally in a rich and planned environment. Learning takes place effectively only if activities are planned according to the curriculum and as guided by CAPS. The environment should allow learners to construct their conversations, through the levels of the Zone of Proximal Development (ZPD). Conversations among learners develop around the resources they are exposed to. The teacher should be able to observe how learners play and interact by asking relevant questions and attempt to solve own problems in a Mathematics lesson. The environment should allow thinking that has to be applied by learners. Bowie, Venkat and Askew (2012) point out that while teachers are expected to interact with learners and to be involved in giving guidance and respond to learners' questions, they do not cover the curriculum. The rush of chasing curriculum coverage, is done at the expense of teachers' understanding of

the content they are teaching. This has brought about the level of conversations the teacher should have with early grade learners.

This study used the interpretivist paradigm and incorporated the principles of constructivism by Vygotsky that cast light on social interaction within the learning environment. The teachers' and learners' lived experiences are important. Things around us and knowledge that children are born with make sense within the theoretical framework of social interaction. According to Vygotsky (1987), problem solving takes place under the guidance of a competent adult or capable peer. Mathematics could be an enjoyable subject if there is expert intervention.

Montague-Smith and Price (2012) postulate that if we want to teach children Mathematics effectively, we need to address our own attitudes towards the subject. We do not need to be geniuses to teach Mathematics; in addition, geniuses are not necessarily the best teachers: they may have found it so easy to master mathematics but unable understand why children cannot just see it. It becomes the duty and responsibility of the teacher to make sure that what is taught to learners in the early grades as number sense is well understood by the teacher first and know how learners learn.

The basic Mathematics that learners are expected to be taught in the early grades forms the basis of the mathematics that they will need in the higher grades. Montague-Smith and Price (2012) show that although there are people who see Mathematics as a series of unrelated facts which should be remembered, Mathematicians see it as an interconnected network of concepts; the only difference between basic and advanced maths is the progression and the complexity of how the counting is learnt in the higher grades.

1.6 THEORETICAL PERSPECTIVES

According to Abend (2008) theory assist the explanation of aspects in a logical manner which may also indicate the way reasoning amongst authors evolved. Theory encompasses a set of concepts that relate and seek to explain the purpose. The set of concepts are pointed out and Patel (2015) aver that all the sub-topics of the study guide the research work in its entirety. The theoretical framework forms the outline of the dissertation. The content that will be discussed under the sub-

topics are guided by a theory. I have chosen the constructivist theory to guide my research. According to Adams (2007), contemporary educational theories demonstrate that many practical solutions and theoretical ideas, now presented as 'good learning and teaching', have much in common with social constructivist thinking. The experiences of teachers in teaching number sense in early grades were studied. These experiences of the teachers were observed against the strategies, techniques and methods applied during learning and teaching of numbers sense.

Blake and Pope (2008) assert that social interaction is attained through interaction of learners between themselves and adults who assist in disseminating knowledge and skills. Social interaction is observed in learning, in the early grades, within an environment that has relevant learning resources. The provision of resources to teachers determine and provide the opportunity to be used.

In situations where there are no resources, observations are made on how teaching and learning resources are improvised. Learners seem to inherently collaborate in learning opportunities. The DBE (2011) points out that small group sessions should be planned to allow interaction between learners and should be encouraged to "do activities practically, to use language in talking, and be able to record" their mathematical thinking.

Berger (2004) argues that Vygotsky believed in gradual growth and nurturing in the environment as a starting point of learning and shaping of inner process through social interactions. There is contrast found between him and Piaget. Piaget believed in maturity and developmental stages. A learner seen as independent and self-centred in undertaking attentive actions. To the contrary, Vygotsky's theory is based on the Zone of Proximal Development (ZPD) and a learner as a social being. The ZPD is based on different levels at which children can solve problems by themselves and the level at which they can solve a problem being assisted by an adult, the MKO. Once children are able to do a certain task of their own accord, the ZPD is effectively developed. Learners show development when they manage to perform tasks independently. Both theorists are concerned with the development of the young child from different approaches. In this study data will be informed by findings from learning and teaching.

Lloyd and Fernyhough (1999) assert that Vygotsky’s social learning had an impact on children’s functioning at all levels which are beneficial to the learning process. The levels embrace both the cultural, social and developmental levels. The cultural level is involved in relationships between people (inter psychological). The inter and intra psychological levels are the ones that emphasise the demarcations in the ZPD.

Below are two diagrams that show how developmental stages take place in accordance with the social theory of Vygotsky. The first emphasises the ZPD. The second diagram depicts how the ZPD fits into the entire process and different stages in the development of the child.

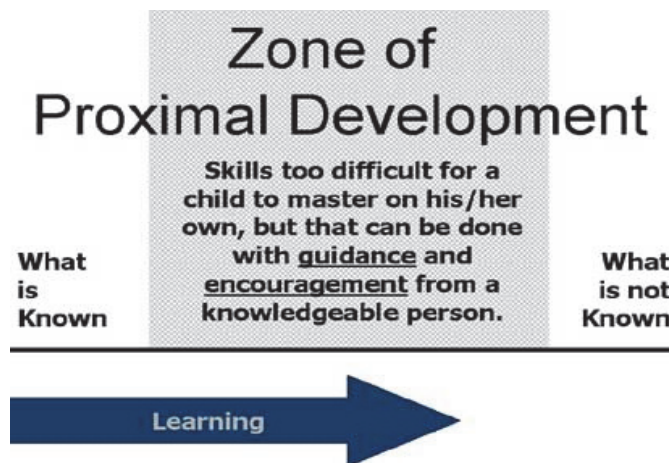


Figure 1.1: Zone of Proximal Development (Source: McLeod, 2019)

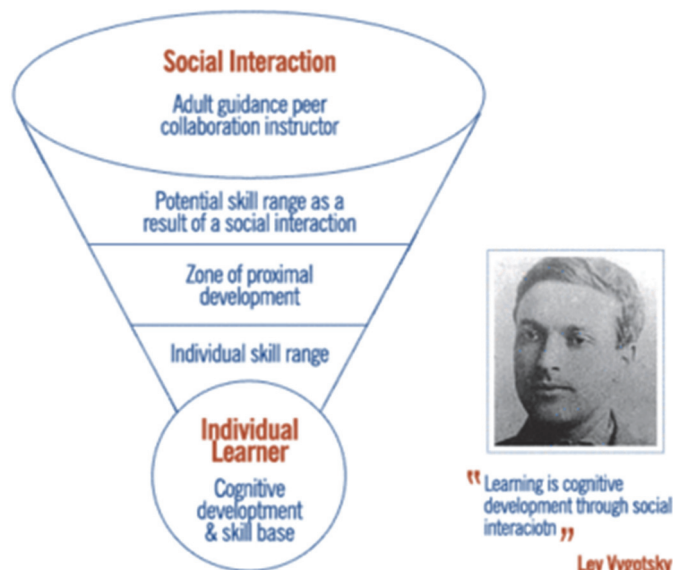


Figure 1.2: Learning is cognitive development (Source: McLeod, 2019)

As I applied the social learning theory, data were collected from the classroom and the school environment. I had constructive conversations about the methodologies and strategies teachers used to teach number sense. The activities planned should indicate that the teachers understood how to teach Mathematics in the early grades. The physical resources were examined to see whether they fitted the content and concepts taught. In my research, I investigated the teachers' experiences when teaching number sense. Kaminski (2002), states that the development and implementation of a number sense programme would benefit education students undertaking Mathematics education. He also argues that in the social constructivist perspective of learning, learning involves the active construction of knowledge through engagement and personal experience.

Learners need an opportunity to explore and construct the meaning of numbers, and student teachers should likewise experience and be given an opportunity to construct knowledge of numbers in their training programme. They need to gain confidence in teaching Maths, and prior exposure will enable them to approach Maths without anxiety. From an ontological perspective, the constructivist holds that there is no single reality or truth (Patel, 2015); reality is created by individuals in groups. This also applies to the opportunities given to both learners in the learning process and teachers in their training. I investigated the resources the teachers were exposed to. Singh (2019) points out that there are cognitive tools that focus on the learning of cognitive skills and strategies in teaching number sense.

1.7 RESEARCH METHODOLOGY

The research design is discussed next.

1.7.1 Research design

According to Maree (2014), a research design is a plan or strategy which is used to select a specific group of participants that participate in providing data that are used during the study. Research design follows a specific plan to involve participants that assist in providing the answers to the interview questions. In this research a qualitative research approach was followed with an exploratory case study design.

1.7.2 An interpretivist paradigm

Reality within the interpretivist paradigm is focuses on lived experiences to generate rich data. Like teachers, who learn by sharing information with their peers, learners learn from each other informally as well as formally in real-life situations. Interpretivist research endeavours to understand the interpretation of individuals' understanding of the world around them (Cohen, Manion & Morrison, 2007:22). Therefore, the interpretive researcher believes that reality is socially constructed and not objectively created. Therefore, the implication is that by locating people in their social context, it is feasible to understand their perceptions regarding their own activities. Roth (2012), indicates that exploration build around social activities done by the teachers from the environment, provides clarifications of a larger atmosphere of practice and has the potential to foster or hinder conceptual thinking in students. In teaching number sense, the teacher needs to reinforce conceptual thinking by giving learners the opportunity to explore and solve numerical problems.

Vygotsky (1987) indicates that mathematical tasks can be attained through collaboration, then allowing independence as the next level of working on mathematical tasks. The independent tasks will have developed from where they will both have learnt from peers or the teacher and gained confidence in doing work or activities independently. The teachers, with their conceptual knowledge, must be able to use the available resources constructively. The lesson plan should be appropriate for the developmental stages and level of the children in the class.

1.7.3 Qualitative research approach

This study followed a qualitative approach, and the researcher endeavoured to gain an understanding of the teachers' experience within a social context. For the purpose of this study, data were collected qualitatively and linked as a means to build a deeper level of participants' understanding of what is taught to correlate it with the curriculum in place (Creswell, 2008). According to Merrill (1997), qualitative researchers seek the enlightenment and understanding of content that can be visualised in similar situations. Through interaction with the participants, the researcher was able to observe and conduct focus group interviews to gain insight into the teachers' experiences when teaching number sense in the Foundation Phase.

Focus group interviews were used in Grades 1-3 classes after contact time in order to determine how the teachers understood the content of number sense. The researcher further probed the methods and strategies applied in the teaching of number sense to learners in the early grades. According to Creswell (2008) qualitative research approach, interviews create opportunities to clarify the misunderstanding or the understanding of both content and pedagogical knowledge that the teachers have. Focus group interviews were effectively used to gather information. The findings on teachers' content and pedagogical knowledge of number sense informed the data that were collected.

Interview questions were developed in such a manner that the teacher was able to focus on personal practices as recommended by Spruce and Bol (2015). The interview schedule together with the questions determined the insight of the strategies and techniques in teaching early grade Mathematics. Usage and application of resources available were part of the focus in the collection process. The usage of resources was observed in the classrooms.

1.7.4 Research type

The researcher engaged with teachers' social interaction when teaching. The study used focus group method. The interpretivist paradigm provided participants the opportunity to relate their lived experiences well. Okeke and van Wyk (2016) explain the interpretivist paradigm according to three headings, namely "re-storying, oral history and storytelling". Memories and experiences were studied by the researcher in order to gain additional information regarding the teaching of Mathematics. The researcher was able to probe where she needed some clarity. She took the semi-structured instruments designed to collect data into consideration to obtain in-depth understanding of the phenomenon under study.

1.7.5 Research methods

1.7.5.1 The role of the researcher

The researcher ensured that the research plan was adhered to according to the preparation of the schedules necessary for data collection. The notes were kept from both the focus group interviews and observations conducted. More knowledge and understanding of the perspectives of teachers as cases in the study will inform

the study on how number sense is taught in the Foundation Phase. The usage of resources, methods and strategies applied in teaching, gave an in-depth experience and understanding to the researcher. The in-depth understanding and beliefs of teachers were probed on the content and pedagogical knowledge of number sense.

My experience as a researcher, as both a teacher and subject advisor also assisted in conducting the research. This experience guided the researcher on how questions could be asked and re-phrased when it was imperative to do so. The conclusions and recommendations that emanated from conversations with the participants are shared in the last chapter.

1.7.5.2 Participants and research site

The research was conducted in a primary school in Gauteng, in the Tshwane North District. Six participants were sampled, two from each grade in the Foundation Phase. They were teaching in Foundation Phase. All the teachers taught mathematics as a subject to their class as part of the curriculum requirements. The teachers who participated in the study had vast qualifications. Some qualified as teachers in Senior Phase, FET, Geology and Certificate in Teaching. They became part of the study as the school was already identified. These teachers were considered to participate because they taught grades 1-3.

1.7.6 Data collection

1.7.6.1 Interviews

A semi-structured interview schedule was used during the interviews. Interviews were conducted on focus group basis. The researcher could help the participants to understand the questions and it allowed the researcher an opportunity to probe further asking questions to obtain more detailed information as recommended by Baker and Edwards (2012). These interviews were audio recorded and transcribed for analysis. The sampling method was purposive, since the selected and participating teachers were specifically teaching Mathematics in the Foundation Phase.

1.7.6.2 Observations

I collected data through lesson observations within a natural setting of the classrooms. Okeke and van Wyk (2016) define the natural setting as any environment that a researcher wants to access and investigate. The researcher observed how teachers applied strategies, techniques and methods in teaching number sense in Grades 1-3. The collected information was recorded in a reflective journal for the purpose of this study. In naturalistic observation, the researcher becomes a participant observer, as explained by Okeke and van Wyk (2016). Subjects were alerted that they would contribute to the data on number sense and their understanding and interpretation of Mathematics were investigated in this study.

1.7.6.3 Sampling

A purposive sampling strategy was used. In this type of sampling, participants were selected or sought after, based on pre-selected criteria premised on the research question. The population for this study was the Foundation Phase teachers in of the Gauteng Province, in Tshwane North District. The collection of data was done engaging six (6) teachers teaching Grades 1 to 3 (Foundation Phase). All of these teachers had to be qualified and teaching Foundation Phase learners. They all had to complete at least a 4-year degree or a diploma in education. Teachers had to be teaching at least one of the grades in Foundation Phase, either Grade 1, 2 or 3. All had to be teaching Mathematics.

1.7.7 Document analysis

The Mathematics Foundation Phase CAPS (2011) was consulted for guidance on the teaching of Mathematics. The CAPS is a policy document used by all teachers in South Africa. It contains repackaged subject knowledge that must be taught to learners from Grade R-3. Mathematics is categorised into five content areas. The Content Area no. 1, is addressing numbers, operations and relationships. It is the section where number sense is highlighted. The number operations and relationships section is weighted higher than all other four content areas. The reason provided by the DBE (2011) for emphasising the Mathematics section is that it is the content area that forms the basis of Mathematics knowledge and understanding.

The DBE (2011) indicates that the general content focus and the development of number sense include:

- the meaning of different kinds of numbers;
- the relationship between different kinds of numbers;
- the relative size of different numbers;
- representation of numbers in various ways; and
- the effect of operating with numbers.

The National Policy pertaining to the Programme and Promotion Requirements of the National Curriculum Statement Grades R–12 (2011) and National Protocol for Assessment, NPA (2011) are policy documents addressing the formal assessment of learners. The two documents provide reciprocal support in addressing the assessment of learners in Mathematics teaching. They support this study as point of departure is to verify the authenticity concerning the level of teaching that can influence learner performance and how to facilitate improvement.

1.8 DATA ANALYSIS

McMillan and Schumacher (2001) point out that in a complete analysis of a conversational interaction, the researcher could go beyond analysing the spoken words and examine the non-verbal portions of the conversation between people. They continued indicating that the tone of voice, pauses, interruptions and the like, enabled the researcher to analyse the phenomenon in place. The conversational interaction provided the researcher the opportunity to delve deeper and observe the complete setting of the research site. The data determined the reliability of the factors that were identified.

1.9 TRUSTWORTHINESS

1.9.1 Credibility

Bell (2010) states that credibility is established in consultation with participants themselves and involving them to read and discuss the data derived from analysis. Lodico, Spaulding and Voegtle (2010) assert that credibility required that participants become the part of description of the process to maximise the accuracy of the study by identifying and describing what was studied, to be judged by

participants. The researcher ensured that the ethical principles were adhered to by all the participants.

1.9.2 Dependability

According to Bell (2010), auditing of the process is one of the ways in which a research study may be shown to be dependable (as opposed to consistent). Burton and Bartlett (2009) state that dependability involved accounting for all the changing conditions in whatever is being studied as well as any changes in the design of the study that were needed to obtain a better understanding of the context. The researcher made sure that the information collected was relevant and remained viable. The researcher depended on all the participants to be fully involved in the research. However, this was not possible, because one of the participants could not take part throughout the whole process. As a researcher, I had to accept this participant's request to withdraw from the study with reasons given.

1.9.3 Confirmability

Bell (2010) asserts that signposts indicating research decisions and influences needed to be present throughout the study and the entire study to function as an inquiry audit. According to Nieuwenhuis (2007), confirmability entails full revelation of the data upon which all interpretations are based, or at least the availability of the data for inspection. All the audio recordings were transcribed and checked by my supervisor to ensure correctness of the transcriptions. Once this was confirmed, the data was analysed and coded.

1.9.4 Transferability

Creswell (2012), transferability involves demonstrating the applicability of the results of a study in one context to other contexts. The researcher explored the context of the site and strived to ensure that the limitations are minimal in collecting data. The data collected will inform scholars and academics who are interested in this field of work.

1.10 ETHICAL CONSIDERATIONS

Ethical considerations are discussed next.

1.10.1 Ethical clearance

Permission was sought from the University of Pretoria to conduct this study. The university as the institution I am registered with, has the power to approve the tools developed to collect data. The school principal signed and granted permission to enter the school in her jurisdiction to collect data.

1.10.2 Informed consent

As a researcher, I wrote a letter to each participant inviting them to participate in this study. I fully briefed each participant about the study and clearly indicated that their participation was voluntary and that they could withdraw any time. The participants who agreed, were requested to sign the consent letter giving permission to include them in the study as participants.

1.10.3 Anonymity and confidentiality

The information shared with me during the process of data collection will be kept strictly confidential. In the documents that the participants completed in the course of the research findings, remained anonymous and may not be disclosed. Pseudonyms were used to protect the teachers' anonymity.

1.11 CONCLUSION

Chapter 1 provided a broad overview of the entire study. Within the teachers' experiences in teaching number sense in the Foundation Phase. Every chapter coming discussed the contents that are being alluded to in Chapter 1 with deeper attention to each.

This project offered me the opportunity to study how teachers teach Mathematics in Foundation Phase. I expected to gain deeper insight into the broad understanding of number sense as the basis of all Mathematics in the learning and teaching process. It is hoped that this study will show how teachers put other principles into practice. The interpretivist paradigm allowed me to study lived experiences and to solicit information during the interaction with teachers while collecting of data. The next chapter deals with the literature review and the theoretical framework is discussed in more detail.

2. CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

Chapter 1 provided the orientation to the study. Chapter 2 shares a brief outline of the in-depth literature review, theoretical framework and concepts. An in-depth literature review was provided focusing on factors influencing knowledge of how teachers teach number sense in the Foundation Phase. Perspectives on the importance of number sense in the early grades, teachers' experiences and challenges as well as strategies to strengthen the teaching of number sense are presented to support the discussions on number sense. The teacher as stakeholder in Early Childhood (ECD) Education plays a pivotal role in the teaching and learning process. The constructivist theory by Vygotsky served as theoretical lens. Furthermore, this chapter explores relevant literature from international, national and local perspectives on the importance of number sense in the early grades, teachers' experiences and challenges as well as strategies to strengthen the teaching of number sense.

2.2 THEORETICAL FRAMEWORK: CONSTRUCTIVIST THEORY

According to Lederman and Lederman (2015) the theoretical framework is the justification of the importance and worthiness of a research. Social constructivism was employed as a lens to support the research to explore the teachers' experiences in teaching number sense. Both teachers' content and pedagogical knowledge were taken into consideration when investigating teachers' experiences in teaching number sense. McLeod (2018) indicates that the Zone of Proximal Development (ZPD) is embedded within social constructivism developed by Vygotsky. Social constructivism holds that knowledge is constructed cognitively. Obikwelu and Read (2012) asserts that both Piaget and Vygotsky believed in construction of knowledge, through developmental levels. Moreover, knowledge or learning is internalised differently. Piaget (1964) asserts that children are exposed to an environment where they learn on their own, without assistance. According to Vygotsky (1987) learners are observed and assisted where gaps become eminent. Piaget is individualistic while Vygotsky is collective and social interaction is viewed as the foundation of development. In this study teachers were observed teaching in their own natural settings. For a teacher to teach effectively, both the teacher and

learners must be conversant with the language of teaching and learning. Language is pre-dominant in social interaction as learners interact with each other and the teacher in the learning environment. Jaworski (1998), argues that the usage of language depends upon the processes of socialisation among people. Social constructivism was employed as it was seen in the process of learning and teaching on a daily basis. The conversations among the teacher and the learner and learners between themselves form the mediation of knowledge.

Vygotsky's (1987) Zone of Proximal Development (ZPD) focuses attention on the opportunity to both the teacher and learner to have a constructive conversation in the learning environment. Conversations take place through verbal language, which is emphasised as a crucial constituent of development by Vygotsky (1987). It was for that reason that this study employed social interaction, which allowed the learning process to take place with utmost understanding. The value of learner support by a more knowledgeable peer and the teacher as caretaker, was underscored.

Language is used to acquire knowledge, and Piaget and Vygotsky concur on the importance of envisaged learner attainment. The understanding of mathematical language for both learners and teachers according to Venkat and Adler (2012) were informed by the interactions where teachers aided the learners to simulate information. The teachers, on their own, need cognitive thinking to assist the learners' ZPD. When the learners understand what is taught, as indicated in figure 2.1 they enter the next level of the ZPD and function independently after the cognitive level has been reinforced through language interactions with the More Knowledgeable One (MKO).



Figure 2.1: Vygotsky's ZPD: (Syafiza, 2017)

Interviews and lesson observations were conducted with teachers who taught in the Foundation Phase more specifically Mathematics. The questions sought to find out how preparations for teaching strategies in the environment were done for learning to take place.

The literature addresses diverse views about teachers' experiences on teaching number sense as well as elucidating the meaning of number sense. Singh (2019) indicates that what learners learn is influenced by the conducive environment with practised routines. He further emphasises that learners grow a sense of belonging where they are able to try out new things and explore the environment confidently. This translates into unfolding the importance of the environment in influencing the process of learning and teaching. Mathematics has become a way of life and a mode that exposes learners to mathematical knowledge according to Kilpatrick, Swafford and Findell (2001). They investigated how Mathematics was incorporated inside and outside the school parameters daily.

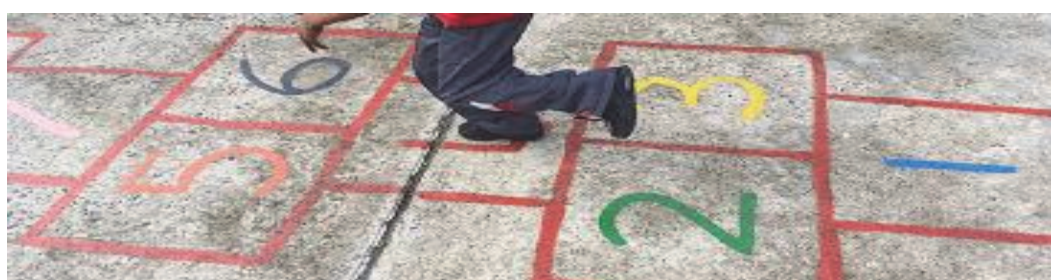


Figure 2.2: Image of Mathematics integration in everyday life (2019)

The teacher, according to this model, becomes an agent to provide a strategic and focused environment which will reinforce learning through diverse teaching methods. Formal and informal language in Vygotsky's social interaction develops with time during interaction within the ZPD. Descriptions given by adults are guiding higher development of learning which encompasses cognitive development. Piaget asserts that learners construct knowledge from their environment, simulating knowledge through the developmental stages. Blake and Pope (2008) emphasise that teachers who can incorporate both theories of Piaget and Vygotsky into their teaching strategies, will improve learner attainment.

Scaffolding is based on the existing learner knowledge when arriving in the formal environment. At home they are able to share sweets equally without knowing that they are learning division which is a concept in the curriculum. The teacher should be able to connect with the learner and build onto prior knowledge. Venkat and Askew (2018) opine that the teacher is a mediator between the objects of learning of Mathematics and the particular learners in the classroom.

2.3 BACKGROUND TO TEACHING MATHEMATICS IN EARLY CHILDHOOD EDUCATION

In order to be able to effectively participate and contribute to the world in which we live, it requires that individuals must know basic Mathematics (DoE, 2009). Wilson, Dehaene, Dubois and Fayol (2009) explain that there are essential skills embedded in number sense. The skills referred to are computations, estimation, counting and comparison of quantities. These skills show up in the actual strategies envisaged in teaching number sense in the Foundation Phase. Sayers, Andrews and Björklund (2016) point out that subitising is seen as part of emergent number formation. If basic skills are achieved, learners will be able to compute numbers at a higher level. They will be able to work out multiplication sums and more complex mathematical concepts.

Martin and Mullis (2013) report that Mathematics achievement and success are a fundamental educational concern in South Africa and across the world, however the poor learner attainment that is experienced, is influenced by learners who are from deprived backgrounds. Hodgen and Marks (2013) indicate that it is critical to be competent in Mathematics, especially in the workplace. The workplace is an adult

space where mathematical foundational skills are still applicable. Mathematics is used differently as everything has to be solved in words. The word problems that are taught should be realistic so that the learners will later be able to draw on knowledge gained at school once they reach the corporate world. Mathematics is imperative within the realms of science, technology, engineering, and mathematics. It is critical to be able to “do mathematics” and to dispose of a strong number sense. According to Arshad, Atan, Abdullah, Atu and Mokhtar (2017), children who leave Foundation Phase with a poorly developed number sense, are predicted to be unable to ever make sense of Mathematics at a higher level. Although international research has found that there is an upward trend in average Mathematics test scores in elementary and middle school, according to Keiper, Sandene, Persky and Kuang (2008), most learners in the United States and even in South Africa still lag behind their counterparts in many other industrialised nations as indicated by Jordaan, Glutting and Rameneni (2010).

According to the DBE (2011), Foundation Phase Mathematics in the South African number sense is weighted 65% in comparison to the other content areas, whereby patterns and functions and algebra are weighted 10%, space and shapes (geometry) 11%, measurement 9% and data handling 5% (DBE, 2011). One reason cited for the increase in the weighting of number sense according to Kilpatrick, Swafford and Findell (2001) is that developing number sense serves as an intermediate tool for learning conventional Mathematics taught in schools. A strong number sense is a basis of success in Mathematics. As number sense develops, Mathematics becomes more meaningful. Van de Walle, Karp and Bay-Williams (2015) argue that a strong number sense enables learners to make sense of their environment and aids them to become numerate people.

The impact on the failure rate experienced internationally is a concern in the learning and teaching process and more especially in number sense. In an endeavour to improve learner performance, GDE came up with GPLMS as a Mathematics Strategy according to (De Clercq, 2014) The DBE (2011) refers to methods and strategies relevant to early grades. Learner improved results will be evident where these methods and strategies, are practised, in line with the content areas shown above.

The focal point of the study is particularly on the teacher experiences in teaching number sense in the Foundation Phase. Being a researcher, it became imperative to investigate the process of learning and teaching through experiences in teaching number sense in the Foundation Phase as a basis in the learning and teaching of Mathematics.

Poor learner attainment is the indication of challenges in pedagogic knowledge. According to Griffin (2004) teachers' challenges emanate from inconsistency of content knowledge to be taught that is not well outlined by policy implementers in higher levels. Moreover, Griffin (2004) points out the three parts, which have to be considered in teaching and learning Mathematics. These three aspects embrace the level of the "learners in your class", the level "aimed at" and "teacher capacity". These aspects involve teacher preparedness and underscore important areas. In addition, Bowman, Donovan and Burns (2001) indicate that the knowledge that people have, is acquired informally, however, there is a need to accumulate more knowledge through intentional learning in a formal educational setting. The formal setting should be a well-set environment, prepared by the teacher for learning to take place.

Learner attainment will be dependent on the way teaching is conducted. The teaching of number sense as the basis of Mathematics, requires carefully selected resources. The resources should be relevant to number sense teaching and should promote number development. The selection will be influenced by teacher knowledge and preparation for learning and teaching. The strategies, methods and techniques applied should include the ability to differentiate teaching of diverse learners in the classroom. The diligence expected from the teacher, is informed by the teacher training they have attended.

2.4 AN EXPLANATION OF NUMBER SENSE

According to Way (2011) the term "number sense" is a relatively new one in Mathematics education. It is difficult to define precisely, but broadly speaking, it refers to "a well organised conceptual framework of number formation that enables a person to understand numbers and number relationships and to solve mathematical problems that are not bound by traditional algorithms in everyday life

situations” (Way, 2011:10). Number sense, is defined differently by researchers, however common terminology is used when defining it. Shumway (2011) incorporates the terms ‘numbers’, ‘understanding’, ‘flexibility’ and ‘relationship’ of numbers amongst others to define number sense. Griffin (2004) asserts that number sense is not a once-off situation, where there are either correct or incorrect answers. Griffin (2004) continues demonstrating that it is rather a process which progresses through maturity with experience that involves knowledge gained. Naudé and Meier (2019) confirm that number sense is a natural understanding of numbers. Way (2011) further asserts that number sense is the basic understanding of numbers, how they relate, and how mathematical problems are solved. Number sense encompasses the holistic interrelatedness of numbers. John-Steiner, Meehan and Mahn (1998) state that systems that function well, provide a framework to investigate and analyse the interconnections of everyday concepts as they are applied to the domains of acquiring relevant knowledge to the subject. In that, number sense is a learning system to understand numbers found in everyday life.

Tsao and Lin (2011) concur with their counterparts in research that number sense is the general understanding of numbers and the ability to make sense when engaging with numbers and moreover, to be able to discover a variety of strategies around numbers. In confirming the understanding of number sense, Tsao and Lin (2011) maintain that learners should be able to solve given problems in testing their own knowledge on how numbers operate in Mathematics. Hornigold (2017) explains that number sense is an adaptable approach of understanding the usage of numbers and the meaning the learner obtains from the experience of engaging with numbers. A broad and comprehensive way to define number sense is explained as a coherent understanding of relationships and seeing numbers and using them in daily-life situations Yang, Hong and McBride (2019). However, their counterparts proffer a different perspective.

Hynes-Berry, (2011) explains that number sense adds meaning to Mathematics from an early age. It is the ability to understand the quantity of a set and the name associated with that quantity. It connects counting to quantities, solidifies and refines the understanding of concepts such as more or less, estimating quantities and measuring. Deeper knowledge and learning of early Mathematics are

entrenched through number sense. It is further indicated that number sense is a fairly new term in Mathematics education. Devlin (2017) refers to number sense as a most important life-skill in modern mathematics.

2.5 THE IMPORTANCE OF NUMBER SENSE TO MATHEMATICS ACHIEVEMENT IN THE FOUNDATION PHASE

Attard (2016) underscores the fact that children have to experience the Mathematics they learn from school by applying it as a meaningful, interesting and worthwhile activity both inside and outside the classroom. Performance by South African children in the national systemic evaluations DBE (2011) as well as in regional Southern African Consortium for monitoring Educational Quality (SACMEQ) and Trends in International Mathematics and Science Studies (TIMSS) studies suggests that learners are not thinking mathematically. The DBE (2011) posits that while it is critical for children to be able to perform the basic operations, knowing their basic number facts and performing mental arithmetic with confidence, learners need to understand flexibility and meaningfulness in Mathematics and apply these with confidence to make sense of the world. Devlin (2017) substantiate that number sense is important to learners in the Foundation Phase, because through in-depth understanding and skills, learners become conversant to use calculation methods. They also gain courage and confidence in thinking flexibly while working with numbers.

Yang, Hong and MacBride (2019) observe that teachers believe that learners have to understand what they learn, and they must therefore, expose learners to activities that require thinking about numbers and seeing relationships and connections rather than arriving at correct answers. Relationships and connections applied in number sense, is a process towards solving problems experienced in all spheres of life. Devlin (2017) asserts that number sense emerges to be a strong and important concept in support of mathematics learning and teaching in the 21st century.

Documentation by Askew (1998) states that a deep and profound understanding of number sense provides learners with an opportunity to work and understand numbers, number names, values of number and their value in the number system. According to Deheane (2011) number sense has three key areas: number knowledge, counting and arithmetic operations which teachers need to take

cognisance of. Aunio and Niemivirta (2010) assert that early knowledge and understanding of number sense during the pre-school age, carries prediction of improved attainment in Mathematics in the Foundation Phase through the learnt relational and basic Mathematics skills.

Mntunjani, Adendorff and Siyepu (2018) state that proficiency in number concepts has been considered as a main objective of teaching and learning Mathematics. This means that number proficiency is equal to number sense proficiency and it is important as the basis for all Mathematics learning and teaching. The explanation of Mathematics is stated by Montague-Smith and Price (2012) as a way of looking and making sense of the world and we do it every time even when we are oblivious thereof. Both learners and teachers should consistently, and consciously, make mathematical connections in everyday instances. Deheane (2011) indicates that in the evolution of Mathematics, number sense has connections in both geometry and algebra. According to the DBE (2011) learners need more time doing activities on number sense and therefore this topic is weighted 65% in the CAPS FP Mathematics.

The table below indicates the weighting given to the five different topics in Mathematics in the Foundation Phase. Numbers, Operations and Relations (number sense) is weighted 65% in Grade 1, 60% in Grade 2 and 58% in Grade 3. The other four sections are all weighted below 15% (DBE, 2011).

Table 2.1: Weighting of the content areas

WEIGHTING OF CONTENT AREAS	Grade 1	Grade 2	Grade 3
Numbers, Operations and Relationships	65%	60%	58%
Patterns, Functions and Algebra	10%	10%	10%
Space and Shape (Geometry)	11%	13%	13%
Measurement	9%	12%	14%
Data Handling (Statistics)	5%	5%	5%

(Source: Adapted from CAPS, 2011)

The high weighting allows creativity that can be expressed by both teachers and learners which underscores consistency in making sense of mathematical

processes and necessary interaction as mentioned by Abdulhamid and Venkat (2017). The teacher should be able to give feedback in the formative process of both teaching and learning. A deep understanding of numbers should be situation-bound, that is, learners should be taught to recognise and understand numbers in their immediate environment. Tsao and Lin (2011) agree that a well-developed number sense can be applied in any situation and context. In his work Singh (2019) confirms that learners can be challenged on number sense and computations by asking questions on real-life situations. Jonny and Mahomed (2011) indicated an example, of a learner buying a shirt and making calculations on what he has, how much he will spend and if there is change, how much it will be. The learner needs number sense to calculate cost, payment and change that they must receive accurately. The understanding contributes to the size and value of the number, how numbers operate and are composed. The learners' ability to use their knowledge and apply their acquired skills, is expected to be exemplified in how the learners interact with numbers in a learning situation where they will represent experiences with operation of numbers built into other contexts they are exposed to. Burns (2007) proffers an explanation of number sense depicting it as flexible number thinking and reasoning to solve problems. Furthermore, he emphasises the understanding of how numbers can be taken apart and put together in different ways. An indication was provided that the importance of connections among basic operations, mental calculations of sums, and reasonable estimates in numbers are also deemed as part and parcel of number sense.

All teachers must ensure that learners understand why numbers have a sequence. Briand-Newman, Wong and Evans (2012) state that young learners who are able to count do not always know why they have to learn to count in school. Learners need to develop a relational understanding where they will follow why two comes after one. The teachers' responsibility is to enhance the importance of number sense and accommodate the knowledge and experience the learners bring to school from home (Bowman, Donovan & Burns, 2001).

Teachers should plan and prepare the learning environment effectively to stimulate learners' understanding of numbers sense. Devlin (2017) clearly indicates that a good foundation of number sense in the early grades will help learners to work from

simple to complex Mathematics problems. The DBE (2011) presents an entire section on the resources that teachers should use effectively for teaching number sense in the early grades. However, Bowie, Venkat and Askew (2019), state that learners who were found lagging behind in number sense, are those who did not develop the basic foundational skills and understanding of number sense. These basic foundational skills are acquired from the home environment through the pre-Grade 1 learning environment. To ensure that all *learners* have a thorough understanding of number sense the figure below indicates a number of lessons and time set aside for number sense. Time is indicated in minutes and lessons per day.

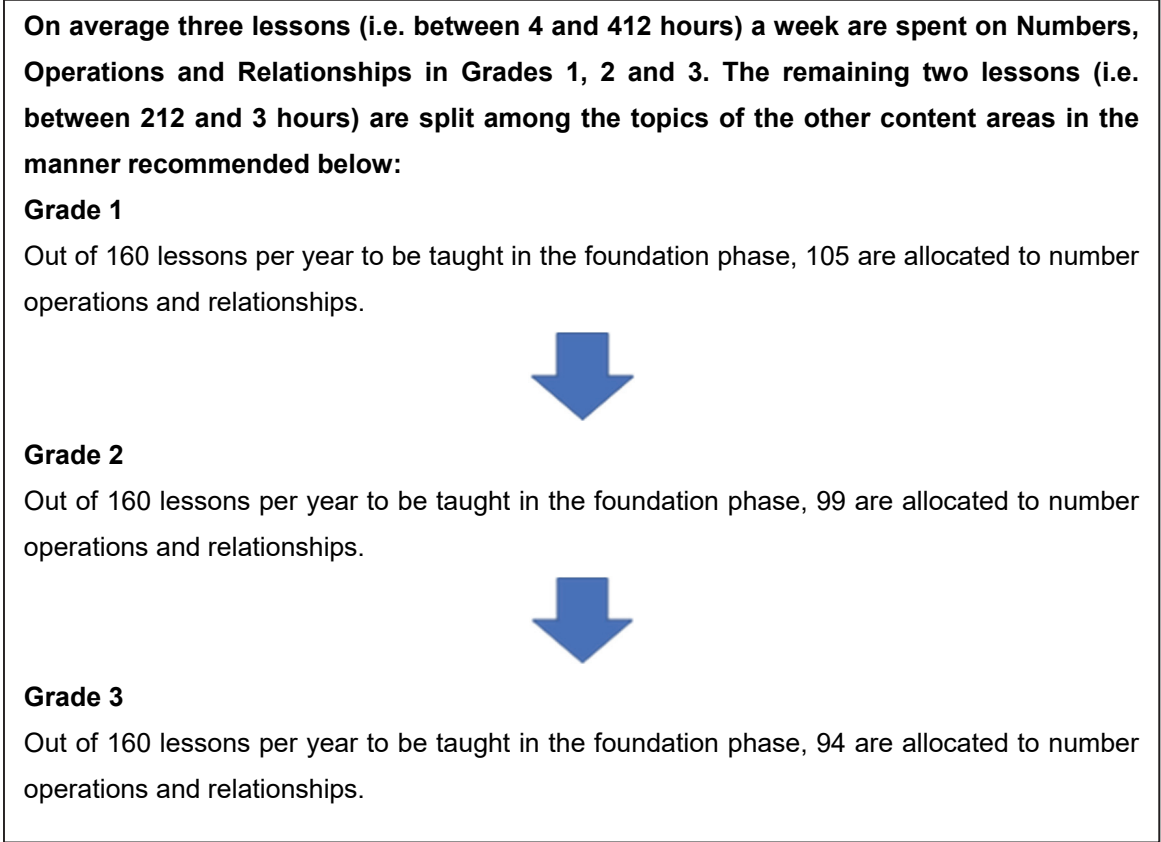


Figure 2.3: Allocation of time towards lessons for Grades 1 to 3 for number sense (Source: DBE, 2011)

Kilpatrick et al. (2001), focuses on the value of number sense in Figure 2.3. Castronovo and Gobel (2012) emphasise that numbers sense is an inherent, fast and intuitive process that enables humans to understand the value of numbers. They explain the differentiation in number sense as “approximate number sense” (ANS) and “exact number sense” (ENS). They indicate that early research alludes to the notion that knowledge of quantity is core from birth. Children cannot verbalise

language yet when so young, however, they share approximate number sense with animals inherently.

Clements and Samara (2007) indicate that as children grow up, they experience maths in their bodies in relation to the environment. The mathematical knowledge gained in the lower grade will impact other subjects in the later years too. Learning mathematics takes place in a complex manner where there will always be connections of situations they are exposed to. It becomes the duty of the teacher to internalise mathematical concepts to make them long lasting and beneficial to mathematics knowledge.

Figure 2.4 below indicates the strands of mathematical proficiency according to Kilpatrick et al. (2001) provides a guideline for teachers in the development of a strong number sense amongst learners in the early grades.

- **Conceptual understanding:** students need to develop an interconnected understanding of mathematical concepts, operations, and relations;
 - **Procedural fluency:** students need to develop an automated, flexible and efficient set of mathematical procedures;
 - **Strategic competence:** students need to be able to formulate, represent and solve mathematical problems;
 - **Adaptive reasoning:** students need to develop the capacity for logical thought and mathematical argumentation;
 - **Productive disposition:** students need to see mathematics as a sensible, useful, and worthwhile subject to be learned, coupled with a belief in the value of diligent work and in one's own efficacy as a solver of problems.
- 1 2 3 4 5 6 7 8 9 10

Figure 2.4: The strands of mathematical proficiency (Kilpatrick, 2001)

2.6 CHALLENGES EXPERIENCED BY TEACHERS TEACHING NUMBER SENSE IN THE FOUNDATION PHASE

The National Curriculum Statement (DoE, 2009), indicates that Learning Outcomes and Assessment Standards describe the knowledge and skills that children should develop throughout their school career. However, many teachers struggle to translate the curriculum into practice.

It is noted that challenges experienced by teachers in teaching number sense, are about how teacher content knowledge is imparted practically in the process of learning and teaching. Arends, Winnaar and Mosimege (2017) explain the importance of a variety of teachers' practices used in interacting with learners in class and the understanding of mathematical concepts in overall Mathematics performance. Poor teaching approaches are elucidated by Mntunjani et al. (2018), by noting that poor teaching approaches are experienced due to lack of usage of concrete manipulatives in teaching number sense.

According to Hill et al. (2005), teachers who teach Mathematics do not only need to do calculations correctly, but need the ability to use other resources such as pictures and diagrams to show representations of mathematics to learners. Briand-Newman, Wong and Evans (2012), emphasise that representations and connections in teaching of the basic Mathematics are a great challenge to teachers. The emphasis is on the integration of aspects and connecting the necessary knowledge comprehensively. It is important that teachers understand the mistakes done by learners during the process of learning and teaching of number sense.

Tsao and Lin (2012) confirm that research has long been concentrating on learner performance rather than on teacher understanding of content in teaching Mathematics in the early grades. They continue indicating that this is one reason amongst others that there is misapplication of teaching strategies and rules brought by misunderstanding of mathematical concepts.

2.6.1 Teacher content and pedagogical knowledge

According to Bowie, Venkat and Askew (2019), teaching Mathematics in South Africa is linked with history inherited from apartheid. This history brought inequalities in the training institutions in the apartheid era, which left Blacks at a disadvantageous level that is still observed in current educational practices. Steyn, Harris and Hartell (2011) cited (Department of Education 1997; Lubben et al.) emphasised that post-apartheid in South Africa, Black students were given access to higher education. With the increase in the number of Black students and learners, teachers were able to tap into their cultural knowledge and understanding of mathematics. Teachers were found hesitant to use their own creativity and to

suggest novel ideas on how to teach Mathematics effectively due to lack of expected competence in their teaching especially accommodating ethno mathematics (indigenous knowledge systems).

Teacher knowledge is imperative for learner attainment and improved learning. There is an assertion by Hill et al. (2008), indicating gaps that are not attended to by HEIs on the impact that teacher knowledge has on learner attainment. In the initial stage, when teachers enter the Mathematics classroom, they need to display particular characteristics. The content of Mathematics in the Foundation Phase should be clearly understood as learning in the Foundation Phase takes precedence in the whole system of Mathematics. Characteristics of what defines a good teacher in a Mathematics class, according to Aunio, Mononen, Ragpot and Tormanen (2016) are underscored as the following: content knowledge, knowledge of resources necessary for teaching, the ability to take decisions, critical thoughts, the ability to solve problems, and understanding of personal views in order to be able to self-correct. Furthermore, reflection on work done; knowledge of learner needs; implementation of new knowledge and findings in education; and the ability to communicate, are all of vital importance.

The above pointers indicate that should a teacher fall short of the above-mentioned characteristics, it would translate to incompetency in Mathematics teaching in the Foundation Phase. The teacher would rather have more than less from the list above. According to Aunio et al. (2016), emphasis is that the responsibility of the teachers to adapt their teaching to suit the learners' level and to address the learners' needs. The teacher knowledge should address the learner needs by showing prior knowledge of the skills to be implemented as cited by Aunio et al. (2016). According to Hill et al. (2005), the major aim of the mentioned characteristics is focused on the teachers' content knowledge and the effort to improve at that level. Ramollo (2014) argues that there is an assumption that active participation portrayed by student teachers' pedagogical reasoning and action process, leads to the formulation of content knowledge.

Brown (2005) explains the importance of the principles for teaching which can be clarified with specific and concrete examples in the classroom. The interpretations are constructed on existing knowledge and facilitate the understanding of number

sense. The teachers have to make it possible for learners to learn and make sense of what is brought into the class. It surfaces that “pedagogical and content knowledge” are intertwined. They both deal with the teaching process, and ways of representing and formulating the subject that make it digestible to learners. The DBE (2011) depicts the specific aims that learners should achieve in the Foundation Phase. For the learners to achieve these specific aims, the teachers should be conversant with the depicted aims. Denson, Austin, Hailey and Householder (2015) proposes ways the teacher can employ in class and provides opportunities to learn more and from others. Amongst others, they indicate that the teacher should facilitate class discussions rather than telling and taking decisions for the learners.

The submission indicates that amongst all other factors, the most important aspects in a Foundation Phase class, is the content knowledge and the pedagogical content knowledge. All other factors rely on how much knowledge the teacher has in teaching Mathematics in the early classes. Stott (2014) attests that Maths can be enhanced by games. The games can be played at school outside the class, at home with others and alone. He further emphasises that Mathematics is found everywhere and can be taken everywhere. The teacher should be able to relate Mathematics to home and to the class. They must be able to make children see the synergy of Mathematics in class as well as outside class. When Mathematics is involved outside, learning occurs in an entertaining way, but it is actually learning through play. A relaxed environment is conducive to teaching and learning. However, teaching Mathematics should be enforced by the adult who is knowledgeable and able to assist as caregiver in accordance with the learners’ unique level of learning also known as the ZPD according to Doolittle (1997).

Steve (2009) asserts that there is a psychophysical perspective of how number sense links with “dyscalculia.” The dictionary provides the meaning of dyscalculia as a specific learning disability in Mathematics. Children with “dyscalculia” have difficulty in understanding the relationship of numbers or using symbols and functions needed in Mathematics.

Such disorders need to be identified at the early age so that learners should not be subjected to work they will never be able to do. The non-identification of such disorders will affect the child for the rest of their lives. Moreover, in teaching, there

are basic signs that the teacher needs to have knowledge of in order to engage the learners appropriately. The teacher needs to have knowledge on the type of mistakes done by learners, and where they emanate from. Venkat and Askew (2017) indicate that there are mediating strands in teaching Mathematics. These strands include spaces which involves the environment, the artefacts which would be the props used in the Mathematics class as well as the inscriptions.

The mistakes or learning that is taking place will be evaluated or assessed only if there are points of reference that assist the teachers to be conversant with the environment they are teaching in. There are instances where teachers expect to achieve results in an environment that is not conducive for learning and teaching. Preparation is amongst the requirements that are necessary to make learning meaningful to both the teacher and the learners.

A prepared learning environment is not only physical, according to Engelbrecht et al. (2015). Learners need comfort of furniture, which is safe and less hazardous. They make sense when they experience some discipline, rules and the consequences thereof as part of the environment.

2.6.2 Teacher training and development

In the South African context, Venkat and Askew (2012) acknowledge that apartheid has had a negative effect on the process of preparing and developing teachers in South African training institutions. The training that took place showed its impact in learner performance. The difference can be compared to the quality of training as seen in the teaching and learning taking place in schools or Foundation Phase classes.

The submission of Venkat and Spaul (2015) indicate that there is comprehensive agreement in international literature on Mathematics teacher education, that teachers require skills and understanding of the content to be taught in Mathematics at the most basic level. They continued to emphasise that the international mathematics teacher education at its initial level should consider content knowledge as a basic requirement to teach. After the basic knowledge of content during teacher training, an intense orientation and induction before the teachers were given their own classes are important. Teachers' experiences influenced the ability to integrate

knowledge and make connections in the Foundation Phase Mathematics teaching. Teachers who are not trained in Foundation Phase methods find it difficult to familiarise themselves with a specialised process of teaching emergent learners.

During teaching practice sessions, teachers are guided throughout the period of their stay in the classroom. Askew (2012) highlighted that when new teachers are left on their own without orientation or support they become overwhelmed to teach their first lesson. In the experience of the researcher, there were instances where new teachers brought a plethora of theory, which was difficult to put into practice in the dynamic environments they found themselves. They were left to rely on their own expertise but lacked practical knowledge of how to go about teaching emergent learners.

The situation experienced by the teachers coming from institutions of Higher Education (HE) presents itself as a gap that has to be addressed for the betterment and improved teaching which will yield improved learner attainment. It should not only be government and HEIs that produce teachers to teach in government schools, the private colleges have to be brought in to share their strategies in teacher training and good practices. There are also programmes that the DBE collaborated on, in its endeavour to improve teaching and learning challenges in South Africa.

McGrath (2010) asserts that private institutions are striving to improve the learning and teaching of Mathematics, science and languages through their internship programme. The project addresses the shortage of teachers in the mentioned subjects in collaboration with both the DBE and provinces within the country. Teachers are placed in pairs in schools while they are training and not at the end of the training. This practice is beneficial and prospective teachers are supported to be effective when joining the world of work. The teachers stay in schools for two years in class with the teacher. They see the practical implications of what is done in classes, unlike coming to class for six weeks only and they are required to teach with confidence the moment they step into the FP classroom.

The Department Head (DH) of a school is expected to orientate the new teacher as indicated in the Employment of Educators Act (1998), but it seldom happens as they

are allegedly affected by the nature of the post they occupy. They have to be fully responsible for learning and teaching in their classes. There are as well managerial activities and responsibilities they have to do. The newly employed teachers are categorised as 'inexperienced' staff members and need the immediate assistance on entry to the school to be supported by the relevant Department Heads (DH). The Employment of Educators Act (1998) has tabulated other duties including the extra-curricular, personnel, general administrative and communication activities needed to be performed by Departmental Heads.

Avalos (2011) posits that professional development is about teachers teaching themselves and translating their gained knowledge into practice with the aim of growing learner knowledge. Teacher development involves both mental and emotional participation of teachers as individuals and collectively. Jung (2005) mentions that in teacher training the emphasis is on the application of rules rather than on the exploration of problems. In teacher training institutions, the approach should allow problem solving, which will be used by trainees in their actual settings in the teaching field. The HEIs currently include the usage of Professional Learning Communities in the College and university curriculum programmes. The Professional Learning Communities are regarded as places where teachers can work together and share good practices. Avalos (2011) indicates that teachers can transform their learning with the aim of benefiting their students. Jung (2005) attests that teachers cannot just be conveyers of knowledge anymore; they should be in charge of creating the environment prepared for learners to construct their own mathematical knowledge.

Duignan and Walsh (2004), in their reporting on the Early Childhood Development and Education, in Ireland, mention the following concerns:

2.6.2.1 Time and the well-planned environment

Time allocation to each component of the lesson is indicated to be influencing the teaching and learning according to Wright, Stanger, Stafford and Martland (2014). This brings the importance of compliance to the timetable according to policy to be imperative. DBE (2011) indicates the time to be spent on teaching each content area. It further indicates the time per period on a daily basis. Time is very important

to be considered during planning for teaching and learning. Lack of planning affects learner attainment on the curriculum.

2.6.2.2 Relevant resources and number lines

Heirdsfield (2011) assert that strategies in early mathematics teaching must be relevant. They refer to the value of the number line that can be used in many different ways. It can be implemented with the whole class, small groups as well as individuals. The afore mentioned highlights the importance of how practical the number line is as a resource to teach number sense.

Factors affecting achievement in schools embrace equipment with resources, which are indispensable to good learning and teaching. The manner in which resources are managed should be taken into consideration as well as the work ethics of the teachers, management of time and planning for teaching, the quantity of work taught and learnt which translates to curriculum coverage and working with resources. Both formal and informal assessment and giving feedback to learners are crucial and learners need to be able to consult resources especially at home. Parental involvement is perceived as crucial influential factor in children's learning progress cannot not be over emphasised (Taylor, 2013).

The DBE as well as Gauteng Department of education have identified schools as per their quintiles to be provided with resources. The DBE (2011) sought to close up the resource gap by providing the colourful workbooks to learners. These workbooks are not used as they were intended. They are meticulously crafted to reinforce concepts taught. The lack of proper use of workbooks and not regarding these as important resources especially by teachers, are aspects which need attention. Materials should be mediated to teachers when they are handed to the schools.

2.6.2.3 Teacher qualifications

Teaching as a noble profession, needs individuals who are qualified and dedicated to the process of learning and teaching; the importance of appropriate teacher qualifications in ECD, can never be overlooked Schifter (2014). ECD teachers should have specialised knowledge on how to deal with emergent learners who learn through play as a learning strategy.

2.6.2.4 Teacher support from School Management Team and Districts subject advisors

The DBE (2016) indicates that leadership, guidance and support from education district offices as well as schools, are critical to attain the envisaged aims within the department. This indicates that it is not only the officials who are responsible to support teachers, but also the schools' leadership that has, equally crucial duty to support teachers at school level.

2.6.2.5 Class size

Engelbrecht, Nel, Nel and Tlale (2015) assert that large class sizes especially experienced in South Africa should not be viewed as the main cause of poor learner achievement. In the school where data was collected, all 6 classes had learners above 40 in number. The number of learners made it hard for the teachers to keep to required discipline during learning and teaching. Muthusamy and White (2005) indicate that discipline problems take up notional time in the large classes. Teachers are not always supported by the School Management Team (SMT) on such occasions due to many responsibilities, and staff who report problems. The adherence to curriculum coverage will not be met as a result of overcrowded and unruly learners. Chise and Tebekane (2017) allude to the fact that individual attention for learners is impossible in the large classes where teachers experience overcrowding.

2.7 STRATEGIES TO TEACHING NUMBER SENSE IN THE FOUNDATION PHASE

Strategies to teaching number sense are discussed next.

2.7.1 Teaching of number, operations and relationships as a content area

Strategies in teaching number sense should be understood comprehensively by the teachers. Venkat and Askew (2017) opine that there are underlying structures of mathematics indicating the number in Mathematics as a primary focus. Foundation Phase is considered to be the most important level in laying the foundation for all learning. It is for that reason that the DBE (2011) found it befitting to increase the time allocated to the teaching of number, operations and relationships as content area. Learners are expected to exit to the next phase with full fluency and secure

knowledge of number sense and operations. The DBE (2011) has expressed the concern about the competency and confidence that learners have displayed with numbers and calculations throughout their formal learning period. Much as the DBE is concerned about learner performance, Spaul (2015) argues that there are inequalities observed in learner performance as measured using both National and International tests such as PIRLS, TIMSS and ANA. These tests do not consider the demographics in the vast area learners are found. Some are in rural areas some in urban and are tested at the same level as well at the international standards which becomes problematic.

The increased and changed notional time to this content area addressing number sense emphasises the attention that should be given to number sense fluency. The teacher is instantly given the responsibility to respond to the changes and follow the relevant guidelines that are proposed by the policy.

A clear plan, knowledge and understanding of content to be taught has to be at an envisaged level. The teacher should have knowledge of the learners and the methods suitable for the learners being taught. In their research, Hill et al. (2005), indicate that there is an increased focus that is given to the teachers' knowledge of the content. They allude to the fact that policymakers too have shown interest in the knowledge of content proposed for teachers. Policymakers expect teachers to be highly qualified. There are different strategies that learners need to acquire in order to achieve the expected level in Mathematics of the Foundation Phase. The strategies should be informed by the knowledge of size, relationships and kinds of numbers which are indicated by the DBE (2011).

Number concept has to be well attained before the calculation strategies can be effectively implemented. The use of concrete props is vital in introducing concepts that work efficiently and effectively for learners. The "maths walk" as named by Humble (2017), is a strategy that the teacher can use to expose learners to mathematics in the environment. The number line can be integrated into the maths walk where the teacher prepares according to the concept that is due to be taught. The instruction during the maths walk can be jumping on the numbers (Figure 2.2) and attaching the props on each number that the learners encounter. The success of teaching number sense depends on the creativity and the willingness of the

teacher to explore mathematical strategies that are embedded in the CAPS. The activities should be focused on the Mathematics concepts. The integration can be applied across concepts within the Mathematics lesson.

Counting by grouping props is a strategy that gets the learners to the next level of counting. According to Anghileri (2001) counting in groups lead to understanding of multiplication. In her account, she refers to the objects in nature and in the immediate environment of the learners. Repeated addition can be a step to use before the multiplication number sentence. While the learners are taken out to the environment, the teacher can fetch some containers for her children in order to be able to group objects they come across according to the activity. This example is given by Clements and Samara (2007). Grouping can be integrated with sorting according to the attributes of the objects. It is very seldom when we find teachers using the environment to expose the learners to Mathematics that is around them. As researchers agree that maths is everywhere, teachers need to have the intuition to explore all avenues to expose the learners to different strategies.

The usage of the environment actively during teaching, has great potential to alleviate the challenge of lagging behind time. The learners will be able to use their senses to interact with mathematical concepts. Learners who are challenged have an opportunity to experiment by seeing and touching concrete objects. In all activities planned for teaching number sense, progression should be carefully planned to indicate progress in teaching and learning.

Latterell and Wilson (2013) allude to their experience of working with teachers who use diverse approaches in teaching early Mathematics. In my experience, where learner performance is considered to be at an acceptable level seen from school-based assessment both formal and informal activities, I found limited strategies used. These strategies are repeatedly used without variation. I have observed non-variation of strategies in instances where learners had to sit for external assessments. The same learners who seemed to perform well, failed when writing the external tests.

The language used seems to be very important in learning Mathematics. In addition, Hartnett (2007), argues that before seriously teaching subtraction and addition,

learners must be acquainted with spoken and written language. Hartnett continues to indicate that knowledge, mathematical ideas as well as mathematical language are connected according to who highlights the value of making it a useful and important process when dealing with numbers sense. Way (2011) reports that counting with understanding is a crucial skill in making connections around numbers.

2.7.2 Counting all

According to Gersten and Chard (1999) counting all is perceived as an ability to add sets of objects and combine them all to count all over again from the first object. This information attests that the basic principles of learning number sense rely on the understanding of the basic language for them to achieve good marks.

According to the Collins dictionary, counting all is when, you say all the numbers one after another up to a particular number. If you count all objects in a group, you add them up in order to find how many there are altogether; learners count all the numbers to achieve a total. While we are addressing the importance of the language in learning and teaching of Mathematics in the early grades, there is a further aspect to be considered on language in Mathematics. The teacher must have knowledge of mathematical language as Wyner (2019) indicates. The language is categorised according to the levels at which learners are expected to achieve.

The practice will benefit the learning and teaching process on the aspect of assessment. A (Figure 2.5) point out that subitising is imperative to achieve in the Foundation Phase Mathematics. In this image, learners will be able to count all by adding all what they see with informed understanding according to the image. The image will as well influence the counting-on strategy which is a next step after counting all.

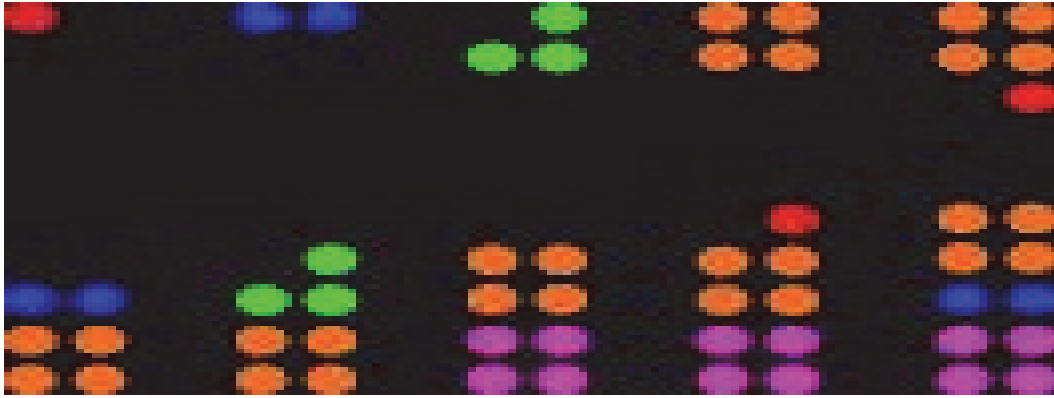


Figure 2.5: Subitising according to colours adapted from Maths for Success (Source: Swan, 2019)

2.7.3 Counting on

According to Humble (2017), counting on is a mental strategy for mental calculation, building on to mental mathematics within number sense. In observation, Way (2011) indicate that counting on activities contribute towards improving the learning of place value, multiplication and division.

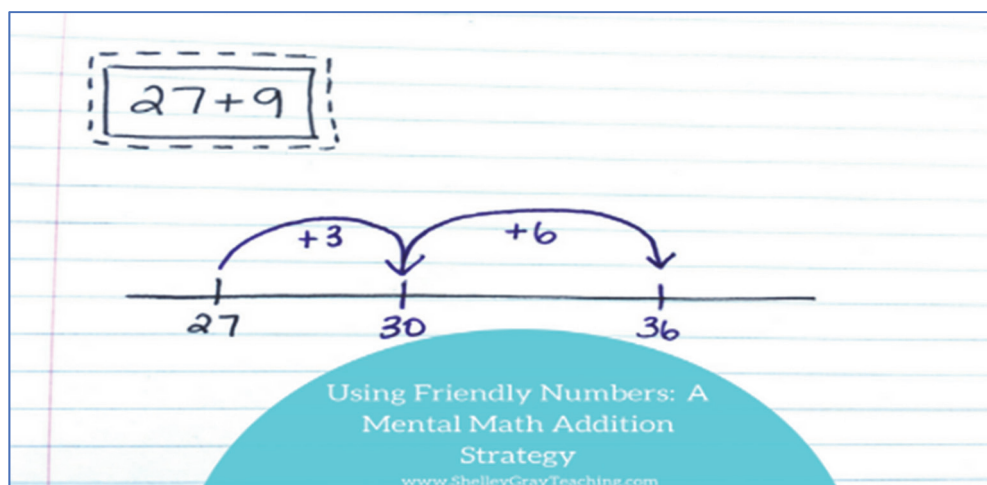


Figure 2.6: An example of counting on as strategy (Source: Shelley Grey teaching)

The figure above indicates that counting on as strategy is applied by starting at the end and then adding. It indicates the usage of the strategy on the number line. The number line becomes the strategy within the strategy to teach and learn number sense. The same strategy can be used as a bridging through ten strategy. It can as well be making a ten which translates to number bonds.

Employing 'a ten strategy' involves the learner to group ten and then arrive at twenty as the example in Figure 2.7 below. The figure shows that in the case of $18 + 5$, the

learner will add a two from the units and fill up a twenty then it will be 20 adding the remaining 3 giving the answer as 23. The basic knowledge should have come from the number bonds.

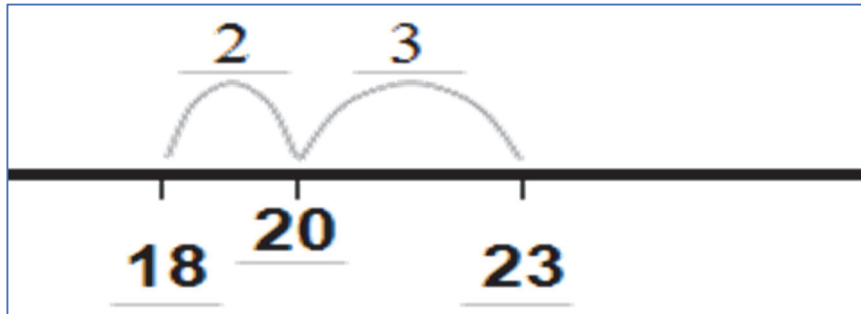


Figure 2.7: The effectiveness of the number line using groups of ten (Source: Maths resources)

2.7.4 The Number line

The DBE (2011) depicts the number line, amongst other strategies, as a method that mediates the teaching of number sense. The usage of number line gives an opportunity to integrate topics in various ways. The topics such as more/less, rounding off, estimation, place value, addition/subtraction and counting in groups amongst others, show integration on the number line. The integration informs the connections that the learner must have in understanding Mathematics. The usage of the number line together with the objects, becomes a skill which has to be used in teaching number sense throughout the elementary years where concepts are introduced.

In most cases teachers choose the simplest content to teach together with conventional methods they are only familiar with. They are afraid to challenge themselves in wanting to know more about Mathematics.

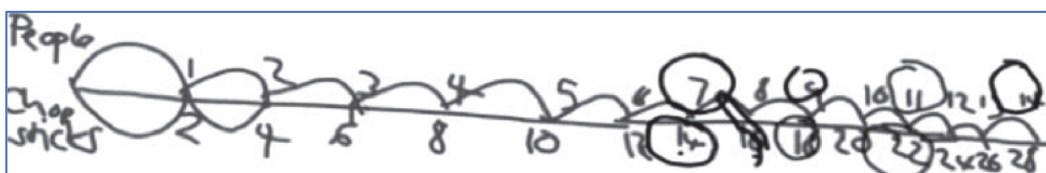


Figure 2.8: Double number line depicting the basic grouping strategy (Source: Maths resources)

2.7.5 Addition and subtraction as inverse operations

Addition and calculation by subtracting:

Example: If $236 + 18 = 254$

Then $254 - 18 = 236$

and subtraction calculation by adding:

Example: $384 - 48 = 336$

Then $336 + 48 = 384$

It has been indicated by Humble (2017) that numbers were long used to grow both science and economy, because they give sense of patterns and can predict the future. This gives sense of teaching learners the flexibility of the numbers. In that, the learners are also expected to be seen making “connections” in diverse situations. The DBE (2011) states that the usage of inverse operations can yield solutions and reasons for teaching addition and subtraction together. These are some of the strategies to be reinforced in teaching number sense. In defining inverse calculation, Ramollo (2014) used the same strategy in testing the student teachers on their understanding of inverse operations. They wanted to find out if the student teachers were able to see the “connections” and representations of the inverse operations in teaching Mathematics.

2.7.6 Place value

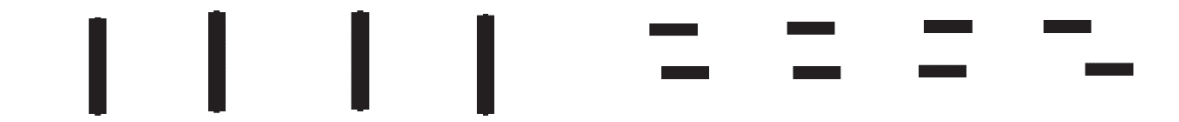
This is a great strategy to begin with. It allows students to have a visual of base ten blocks right there on the paper with them during a test situation. See the following example.

Example: $34 + 48$

First, I draw 34



Then I draw 48



When I add them together I get 7 tens and 12 ones.



Figure 2.9: Representations of place value (Maths resources)

Ten ones make a ten so the learners add that to 70 and they calculate to reach 80. Then they have 2 more to add which gives 82.

2.8 IMPORTANCE OF A CONDUCTIVE MATHEMATICAL ENVIRONMENT IN THE FOUNDATION PHASE

2.8.1 Availability of resources

Graven and Venkat (2017) assert that both teachers and their knowledge of Mathematics are critical resources in teaching. Teachers constitute the most important resource imperative to teach number sense. The teachers as resources, must dispose of the content knowledge of what they need to teach in Mathematics in the Foundation Phase. Mathematics content knowledge has to be coupled with a pleasant personality, positive attitude and creativity in order to yield good and enjoyable Mathematics teaching and learning in the Foundation Phase. Humble (2017) refers to “outdoor maths walks” which the teacher could organise to expose learners to identify instances where maths features even outside the classrooms. The environment is amongst the resources that are available to teach number sense, however, it is used minimally. The utmost usage of the environment as a learning and teaching resource, has to be discovered through a creative Foundation Phase teacher. In using such activities, the focus of teaching maths will shift from wanting to see results to seeing Mathematics as a process which should equip learners for life where learners need to understand and not memorise what they learn (Clarke, Grevholm & Millman, 2009).

There are resources to teach Mathematics in our environments according to Naudé and Meier (2014). While encountering with both indoor and outdoor environments, learners should be able to see things that they can learn from. They should be able to identify connections from the charts displayed. They must make sense of length

and measurement in general. There are trees that can be counted. Seeds can be used to count and make groups required in learning of number sense.

The teachers might identify all the mentioned items that can be used as resources to teach Mathematics in the Foundation Phase. Everything depends on the creativity expected from the teacher. The teacher should not be stereotyped to use only props that are purchased. Teachers, even in rural areas, should be creative and design their own props from objects found in the environment. Graven and Venkat (2017) explain that teachers are expected to be experts; they must have excellent content knowledge, be creative and act as professionals who are willing to develop. All these aforementioned requirements are imperative to close the gap in learning and teaching in order to address non-attainment in schools.

2.9 CONCLUSION

This chapter addressed the challenges experienced by teachers. These were supported by literature. The theoretical lens was discussed. Vygotsky's tenets on learner support and assistance by more knowledgeable peers were shared. The theory is very applicable, since Mathematics teaching requires intensive support by the teacher and those who have mastered the outcomes. Many challenges were inherited from previous situations in South Africa, since learners were deprived of proper education due to the Apartheid legislation as pointed out by Fiske and Ladd (2004). The Apartheid regime affected both teachers' content and pedagogical knowledge in a negative way. Both content and pedagogical knowledge influenced the learner attainment tremendously. Wium and Louw (2011) maintain that the poor performance experienced in South Africa is tantamount to misconduct; the situation translates to denying learners one of their basic human rights, which is acquisition of knowledge through learning and teaching processes. Enthusiastic teachers who are qualified and trained to teach Mathematics effectively are crucial to turn around the poor Mathematics results of the past. The next chapter discusses the research methodology.

3. CHAPTER 3: METHODOLOGY

3.1 INTRODUCTION

In chapter 2, an in-depth literature review was conducted to investigate the teacher experiences in teaching number sense in the Foundation Phase. The focus was on experiences, strategies and methods used by teachers in their classroom when teaching number sense. The evidence that surfaced was that teachers are not yet at the level of teaching expected of them as yet measured against CAPS requirements. Through interpretation the researcher constructed understanding of teachers' beliefs and experiences in teaching number sense in the Foundation Phase. Vygotsky's model on Zone of Proximal Development (ZPD) exposed the researcher to understand the aspects that the teachers need to know for them to teach number sense effectively.

This chapter is on methodology, research design and methods applied in supporting the interaction with the participants to highlight teachers' experiences in teaching number sense in the Foundation Phase. Other procedures to be employed in this study are; approach, data collection, sample selection, processes, ethical considerations and the research limitations of the project in the research process in its entirety. The research design within the interpretivist paradigm was imperative in creating a blue print guiding the research process as explained by Rodrigues, Rodrigues and Da Rocha (2012). The description of methods used was necessary to inform the process in data collection. Trustworthiness and all ethical aspects were taken into consideration for the study to conform to rules in place.

3.2 RESEARCH DESIGN

According to Rodrigues, Rodrigues and Da Rocha (2012) research design is defined as a structured and logical plan which allows a phenomenon to unfold and data to be collected at a research site where research questions will be answered. In this study, the logical plan included schedules for both interviews and observations of teachers teaching number sense in their natural settings. During observations and interviews, the researcher found the need to adjust and to probe further on the questions that were pre-prepared. Burton and Bartlett (2009) confirm that while there is a plan to be adhered to, there might be a need to modify planned

processes as the events unfold. It is confirmed by Bell (2010) that the researcher is allowed to change decisions taken before, with the aim of ensuring that results become more reliable.

Data collected were gathered qualitatively. Mnisi (2014) explained that through a case study rich data are gathered on site by interrogating details within a phenomenon to answer the research questions. Perspectives and experiences of a phenomenon are well elucidated when cases are compared according to Baxter and Jack (2008). Latterell and Wilson (2013) study show that the perspectives and experiences considered holistically, provide the opportunity to identify all possibilities to pose questions in an effort to solicit answers to the research questions. The study sought to observe teachers' experience of teaching number sense in the Foundation Phase.

3.2.1 An interpretivist paradigm

This study adopted a qualitative research approach to address the research questions within the interpretivist paradigm. In this paradigm Taber (2013) explains that the intention of the paradigm within social science research clarifies the approaches applied in research. On the other hand, Bisschoff (2017) document that the participants are actively involved and it is where they display their beliefs about the phenomenon in place. Epistemology cannot be left out when we address the teachers' experiences in teaching number sense. In addition, Tennis (2008) defines epistemology as a way of knowing concepts and representations and systems; the knowledge created will give clarity on what is known to the participants in research. It can be gathered that epistemology is very important in teachers' experiences to teach number sense in the Foundation Phase. In this study teachers had to unfold and give knowledge to learners through their logical plan, experiences and resources to support learning that is in place and accessible to them.

Similarly, Creswell (2007) asserts that within the logical system of knowledge-epistemology participants find an opportunity to explore their own setting in the interpretivist paradigm. This explains that the participant as a case is afforded more opportunity to know, explain and explore the world they are in further through their systematic view of their own reality (Tennis, 2008).

Meaning within interpretivism is constructed by being able to interpret a phenomenon and apply it diversely McGee, Wang and Polly (2013). The participants' interpretation of teaching number sense in the Foundation Phase was based on classroom observations, data from interview schedules and anecdotal notes taken during class discussions in their natural setting. The experiences of teaching Mathematics were reported during interviews. Participants had the opportunity to express and understand both the successes and challenges they experienced during the teaching of number sense in their classes on a daily basis. My presence as the researcher facilitated quality and first-hand evidence that informed this study project. Through this study, participants had the opportunity to reflect on their own teaching situations in teaching number sense in the Foundation Phase. They were able to suggest and underscore what sort of assistance they needed. The selection of three different grades (1, 2 and 3) brought diverse and rich contextual factors they are experiencing.

3.3 QUALITATIVE RESEARCH APPROACH

A qualitative approach was used because the interest of the study was providing a rich description of the teachers' content knowledge and instructional strategies in teaching number sense in the Foundation Phase. According to Sibuyi (2013) qualitative research befits the researcher's endeavours to describe what is being observed in the social world of both teachers and learners in the learning and teaching process. The social world in this case will be the classroom where observations took place. Creswell (2012) elaborates that qualitative research seeks to elucidate deep understanding and how it is constructed around a phenomenon under investigation.

In this study the phenomena under investigation were the teachers' knowledge of number sense and how they were able to teach the concepts of number sense in the Foundation Phase. Creswell (2008) suggests that the researcher should conduct the studies in the "field" where the participants work. In the context of the study the "field" represents the classroom situation where the teachers teach and interact with learners. Such interactions are seen as important for gaining some insight into what the teachers are saying and doing in the process of learning and teaching. Furthermore, more personal and interactive modes of data collection,

such as interviews, observations and document analysis are predominant and were used to collect data for the study.

The collection of data was done engaging six (6) teachers teaching Grades 1 to 3 (Foundation Phase). The intention of the researcher was to describe and interpret how strategies and methods for teaching number sense were taught. The intention of the study was to observe how teachers taught, and my presence on site, assisted me to observe how learners responded to the content they were taught. Terre Blanche and Seedat (2001) indicate that the presence of the researcher will be an advantage to identify the gaps that might exist in the learning and teaching process.

3.3.1 Research type: Multiple case study

Participants in this study formed the 'case study.' They are named case study as they bring forth in depth information about their experience in the teaching of number sense. The knowledge and experiences shared by the teachers guided the study in teachers' ways of teaching number sense in the Foundation Phase. This information strengthened the study in either way with positive or negative information. Similarities and differences could be identified and relevant or irrelevant information traced. So, it was my duty to filter the most needed data collected through the case study. The study drew teachers' knowledge and their experiences in teaching number sense in the Foundation Phase and data from interviews and observations of the cases were selected for the study. According to Maree (2007) a case study is explained as an opportunity given to the researcher to observe a process in which a phenomenon is understood and elucidated to the learners during learning and teaching. The indication by Creswell (2008) on a multiple case study is that the involvement of participants in different categories forms the multiple case studies. In this study only, teachers were the source of data through a phenomenon that informed the teaching of number sense in the Foundation Phase in Grades 1, 2 and 3. Learners were indirectly involved as the focus was on teachers' experiences in teaching number sense.

3.4 RESEARCH METHODS

3.4.1 Research site and participants

3.4.1.1 Research site

The data was collected from a primary school in the North of Gauteng Province. It is a township school, surrounded by informal settlement. This school accommodate learners from low-income households. English is the language of learning and teaching at these schools. The parents in the school are middle working-class professionals. However, because of the demographics in Gauteng Province, there are learners from other informal settlements who are transported to the school by buses. Some of these learners are from the neighbouring countries such as Malawi, Mozambique and Zimbabwe.

3.4.1.2 The selection of participants

Creswell (2008) maintains that selection of participants should be purposive and focused on cases that will fulfil the requirements of the study. The teachers who took part in the study, have professional qualifications and were expected to assist me as the researcher to answer the research questions. The focus on the selection was on teachers teaching Mathematics to the Foundation Phase learners. The five (5) teachers who participated in focus group interviews hold the following qualifications: first teacher has qualified in Bachelor in Education Degree in Further Education and Training B. Ed (FET) as her professional qualification. The second, Senior Primary Teachers Diploma (SPTD), National higher Diploma educational management. B.Ed. Hons learner support FP. The third, University Diploma in Education (Primary) and ACE Curriculum and management. The Fourth, B.SC Geology and PGCE, and the fifth, Junior Primary Teachers Diploma and B Tech Education management. The sixth teacher could not give her qualifications.

According to Creswell (2008) there are two other methods one can apply in selecting the cases for research, which are probability and non-probability sampling.

These methods gave an opportunity to continue with the selected participants even if they were not within the criteria in place according to their qualifications. It is indicated by Bell (2010) that non-probability methods do not have restricted criteria for selection of participants, hence the researcher embraced the volunteers and it

became an added opportunity to look at teaching of number sense in an in-depth way in Foundation Phase. The situation was revealed after the school was identified and data collection processes had commenced. The participating teachers agreed to voluntary participation and they were informed of their right to withdraw.

Amongst the participating teachers, I found that the newly appointed teacher's qualification is BSC Geology, with added "methods of teaching certificate" for a year. The teacher was allocated a Grade 2 class. The other teacher who had a B.Ed. FET taught a Grade 1 class. When the selection of the school was done, it was assumed that teachers in the Foundation Phase would be relevantly qualified and correctly placed, because of the nature of teaching in Foundation Phase. I had no control over the situation found in the school as these teachers had volunteered to participate in the study.

I indicated the ethical process that allowed and not compelling them to take part unwillingly. Indicated that my role is a researcher and not subject advisor. I kept to the ethical considerations in the case of two teachers who did not participate in the complete process of data collection. I selected the participants for the purpose of observing the ways teachers are teaching number sense within their own natural settings, however the demographics are presented in the table below.

Table 3.1: Demographics of participating teachers

	TEACHER 1	TEACHER 2	TEACHER 3	TEACHER 4	TEACHER 5	TEACHER 6
Grade	1	2	2	3	1	3
No of learner class	43	52	46	60	44	60
Years of experience in FP	2	9 FP 2 Intermediate Phase	1	25	25	n/a
Qualification	B.Ed. FET Consumer studies	UDEP ACE Curriculum and management	B.SC Geology-PGCE	JPTD B Tech Education management	SPTD National higher Diploma educational management B.Ed. Hons learner support FP	n/a
Institution of training	Tshwane University of Technology – TUT	Moretele College of Education	Free state University	TCE Tshwane University of Technology TUT	Teacher College of Education-TCE Tshwane University of Technology-TUT University of Pretoria UP	n/a
Content workshops attended	Counting	Measurement Time Problem solving	Counting	Number line	Problem solving patterns	n/a

3.4.1.3 Sampling criteria for participants

The purposive selection required that the participants be teaching in the Foundation Phase and in addition the following was outlined:

- Teachers must be teaching in the Foundation Phase;
- Teachers must be qualified in Foundation Phase teaching;
- Teachers must be teaching Mathematics; and
- Teachers must have experience in teaching in the Foundation Phase.

3.5 THE ROLE OF THE RESEARCHER

In qualitative research, the researcher is the centre as they are immersed in all processes around data collection according to Bell (2010). Researchers need to establish a good relationship with their participants to yield the required results (Cohen, Mannion & Morisson, 2007). Hence, Nieuwenhuis (2007) adds that the researchers act as instruments within the process of gathering data and their role becomes imperative. The researcher engaged with the teachers in their natural settings as participants in the study. As the centre of research process, data were collected in a focus group. This increased the validity and credibility of the data collected.

The forging of the relationship between the researcher and the participants have prospects of high level of trust between themselves according to Creswell (2008). This relationship creates an opportunity to the researcher to draw more in-depth data that could enrich the findings in the study.

In the relationship with the participants, the researcher should be careful to remain professional and sensitive to what the participants are exposing as information, however honesty should not be compromised. This is brought to the fore as the questions asked were open-ended and participants would divulge personal information which did not inform the study. The researcher needed to remain guided by the structure in place while they were listening to all that was said. In recording and analysing the data filtering of facts could be done. The researcher in a naturalistic setting, is afforded an opportunity to acquire a holistic view of participants' experiences and contributions explained by Wilson (2017). The

researcher contributed towards the study through own experiences as a subject advisor with knowledge of what number sense and the strategies that should be employed in teaching in the Foundation Phase entail.

3.6 DATA COLLECTION

It was imperative that I had to introduce myself to the principal of the identified school. I did that telephonically and scheduled an appointment to explain the purpose and why I identified the school to collect data and conduct interviews. One primary school was identified and six teachers who taught in the Foundation Phase – Grades 1-3. I had letters prepared for the principal, teachers and parents asking for permission to collect data. I explained the topic and gave the background thereof. I even made them aware that ethically, they were not compelled to take part in the project, since it had to be voluntary. Any participant could even withdraw without any implication on the project whatsoever.

Lodico, Spaulding and Voegtle (2010) assert that the researcher must keep a record of all field notes and records that were observed. Audio recording was used and participants' permission was sought. The schedules were used to collect data during the observation of lesson in teaching number sense. The understanding of the phenomena was central in the process. Creswell (2012), indicate that using a case study makes it possible for the researcher to acquire data in a descriptive and explanatory way which will add to in-depth and rich data. Semi-structured interviews (Nieuwenhuis, 2007) and notes assisted me in arriving at in-depth and rich, descriptive data. He further mentioned that participants must be afforded the opportunity to answer predetermined questions on the phenomena.

3.6.1 Data analysis

According Nieuwenhuis (2007) data analysis is a process that involves transformation of data with the purpose of drawing conclusions that will support decisions made in the study. Creswell (2008) indicates that data analysis is about making sense of what the participants are giving in conversation through open-ended questioning giving the researcher an opportunity to understand and know how to record the findings. Clear understanding comes with thorough interrogation of notes, audio-tapes and verbal discussion that took place during both interviews

and observation processes. It is therefore evident that during data analysis tools are used to test the findings in research through interpretation of personal understanding.

Nieuwenhuis (2007) demonstrates that there are procedures and processes assisting researchers to interpret and understand collected data and analyse it. These procedures and processes would include descriptive methods to describe the phenomenon being studied. A systematic approach in qualitative data analysis, is explained in detail by Creswell (2012), clarifying that it is a manner in which in-depth messages are decoded to summarise conversations. The in-depth message comes through conversations and is further probed by the researcher and the participants. Participants are able to bring their own experiences, beliefs in perspective.

3.6.2 Limitations

Due to movement of teachers from one school to another, the identified school was challenged as the teachers in the phase had diverse teaching experiences. Their qualifications were not particularly for the Foundation Phase. Recruitment was done as an urgent matter with the consideration of leaving learners without a teacher for a long time.

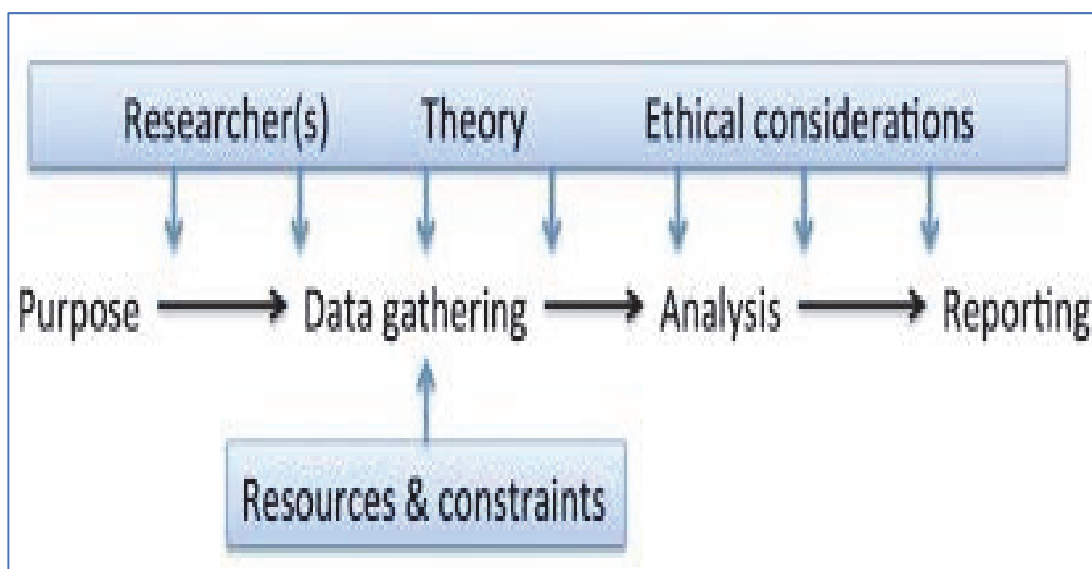


Figure 3.1: Semi-structured qualitative studies (Source: Blandford (2013))

Step 1: Data collection

I collected data from participants at the research sites using open-ended interviews, spontaneous conversations and practical sessions. A journal was kept of all discussions and practical, written pieces were kept to inform me as the researcher.



Step 2: Data handling

I then transcribed the interviews from journal notes so that they were prepared for the analysis.



Step 3: Coding and Categorising

I then read through all the data to get a general idea of all the collected data and started to code them.



Step 4: Discovering patterns

After themes were discovered, I looked for relationships among them and moved back and forth between the codes and themes.



Step 5: Identified themes

Broad and sub-themes were identified from the data collected from interviews with participants.



Step 6: Writing the report

Finally, I used these codes and themes for the final research report. Quotes used in the narratives were transcribed.



Figure 3.2: The data analysis adapted process (Source: McMillan & Schumacher, 2010) and Creswell (2008)

Maree (2014) asserts that multiple realities are embedded in the data and are identified through the interpretive approach within the interpretive paradigm. The process enables the researcher to make informed decisions on selecting the imperative information as summary of the findings. Teachers' interviews were verified and put into categories according to the themes developed in processes through the steps in sets of standards for evaluating quality in qualitative research (Creswell, 2008). In this instance, there were similar sentiments amongst the participants that informed how teaching number sense in Foundation Phase is perceived.

Teachers' experiences shared during interviews provided evidence towards reporting on number sense in the Foundation Phase. The different perceptions of how to explain number sense, were noted to inform the recommendations to be made. Recommendations were summarised according to how participants responded to the questions posed to them. Creswell (2008) points out the importance of using different techniques to validate findings to ensure that the report is credible and accurate. Following hereunder are the elements to validate data collected.

3.6.2.1 Trustworthiness

The next table illustrates the criteria of trustworthiness.

Table 3.2: Depiction of criteria for trustworthiness in qualitative research applied in the study

Criterion	Strategy employed
Credibility	<ul style="list-style-type: none"> ● Prolonged engagement ● Peer briefing ● Triangulation ● Member checks
Transferability	<ul style="list-style-type: none"> ● Providing thick description ● Purposive sampling
Dependability	<ul style="list-style-type: none"> ● Create an audit trail ● Triangulation
Confirmability	<ul style="list-style-type: none"> ● Triangulation ● Practise reflexivity

(Adapted from Creswell, 2008)

3.6.2.2 Credibility

Lodico et al. (2010), state that credibility is established in consultation with participants themselves and involving them to read and discuss the data derived from analysis. Maree (2014) states that credibility requires that participants become the part of description of process to maximise the accuracy of the study by identifying and describing whatever is being studied, to be judged by participants.

3.6.2.3 Transferability

According to Creswell (2008) transferability involves demonstrating the applicability of the results of a study in one context to another. As a researcher I explored the context of the site and strived to ensure that the limitations were minimal in collecting data. The data collected would then inform scholars who would be interested in the same work. The data collected will inform scholars and academics who are interested in this field of work.

3.6.2.4 Dependability

According to Bell (2010) auditing of the process is one of the ways in which a research study may be shown to be dependable (as opposed to consistent). Way (2011) states that dependability involves accounting for all the changing conditions in whatever is being studied as well as any changes in the design of the study that was needed to obtain a better understanding of the context. I made sure that the information collected was relevant and I remained alert to ensure that the information was a true reflection of the actual perceptions.

The researcher made sure that the information collected was relevant and remained alert to ensure that the information remained viable. The researcher depended on all the participants to be fully involved in the research. However, this was not possible, because one participant got involved in the observation process and the other left during focus interviews session. As a researcher, I had to accept these participants request as per ethical considerations applied in the study.

3.6.2.5 Confirmability

Bell (2010) asserts that signposts indicating research decisions and influences should be present throughout the study and the entire study should function as an

inquiry audit. According to Way (2011), conformability entails full revelation of the data upon which all interpretations are based, or at least the availability of the data for inspection. All data will be made available for inspection where necessary.

All the audio recordings were transcribed and checked by my supervisor to ensure correctness of the transcriptions. Once this was confirmed, the data was analysed and coded.

3.6.2.6 Triangulation

Marvasti (2004) explains that triangulation is an approach through which validation and establishment of trustworthiness are ensured and data are collected using various methods. Variation of methods Riyanti (2018) is meant for reciprocal support and verification. The participants had to be able to discover some aspects that they were not taking into consideration when reflecting on their teaching methods applied in teaching number sense in the Foundation Phase. Moreover, I endeavoured to validate the process, and probed their knowledge and focused on how they taught and consistently applied the instruments between lessons during the actual teaching. Data triangulation involves the use of various methods to extract data to ensure reliability. The process enabled teachers to share their own understanding of how they planned and used the resources available in their setting. So, data were compared from each case and the impact of methods used were validated through comparison of data that emerged from the conversations.

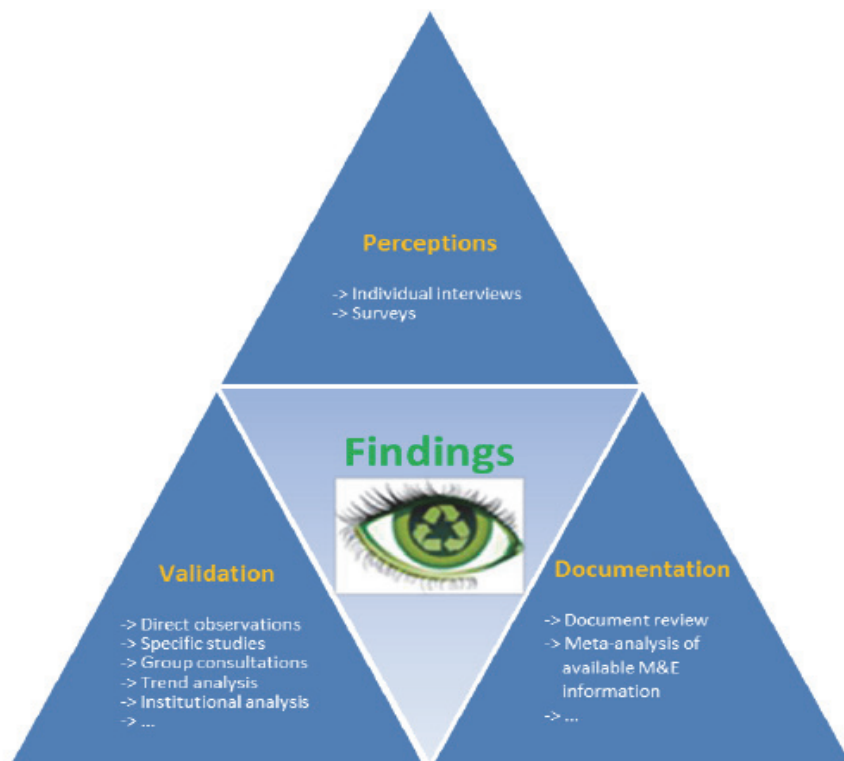


Figure 3.3: Clarification on what triangulation (2016)

3.7 ETHICAL CONSIDERATIONS

3.7.1 Ethical clearance

An application for ethical clearance was completed and sent through to the Ethics Committee of the University of Pretoria. I waited until the approval returned and I was given permission to collect data. The letters to different people who needed to know and participate in the research were compiled and disseminated. All letters needed consent to be returned to the researcher to be kept as evidence of consent given. I clarified the data collection processes and motivated the study in the letters to the personnel addressed.

3.7.2 Informed consent

I liaised with the school to be assisted to send consent letters to the learners' parents. The letters were disseminated and responses were returned and safely kept. During observations, I sought permission from the participants to use the audio-tape recorder for the purposes of capturing authentic information.

3.7.3 Anonymity and confidentiality

Interviews were conducted solely between the participants and the researcher. No information was linked to the individual participant. All data remained anonymous and were kept confidential. Pseudonyms were used to ensure participants' protection. The compilation of participant information did not share personal information of any of the participants. Data collected will be kept safely and be accessed by only the researcher and the supervisor for purposes of authentic transcriptions of recorded and written information. Anonymity was ensured by providing code names to the participants.

3.8 SUMMARY

In this chapter the methodology was presented on how to conduct research with regard to soliciting data on teachers' strategies to teach number sense in the Foundation Phase. The qualitative approach and research methods were elaborated on. The qualitative approach informed the sampling used. The research method addressed the cases in the research and the research design addressed the descriptive process of collecting data. Finally, the role of the researcher, trustworthiness and ethical considerations were discussed. In the next chapter, data are analysed and discussed and the results are presented.

4. CHAPTER 4: DATA ANALYSIS AND RESULTS

4.1 INTRODUCTION

In Chapter 3 I discussed the research methodology used in this study in detail. The focus of this chapter is on presenting and discussing the results of the study. The data collection process was guided by the main research question and supported by the secondary question. The research questions for the study were:

4.1.1 Primary question

- How do teachers experience the teaching of number sense in the Foundation Phase?

4.1.2 Secondary questions:

- What strategies and methods do Foundation Phase teachers use to teach number sense in the early grades?
- What kind of support do teachers receive to strengthen their teaching of number sense in Foundation Phase?

It was important that I determined the relationship between the data and the theoretical framework. In order to achieve an understanding of what the data revealed, I had to make an in-depth analysis of the relationship between theoretical framework as set out in Chapter 2 of this study and the collected data. The data analysis strategies, as set out in Chapter 3 were applied. The correlation between the data analysis and the theory that became evident during the literature review in Chapter 2 became clear.

The data were collected from teachers in the Foundation Phase. I had the opportunity of recording all the interviews with the permission of the participants. The semi-structured interviews were conducted with the teachers, with the objective of collecting rich, descriptive data based on the teachers' personal experience and perspectives.

Chapter 4 presents the research findings, commencing with a description of the participants. Themes and sub-themes were formulated and categorised according to the participants' submissions on their experiences in teaching number sense in

the Foundation Phase. Moreover, the data collected during the focus group interviews were transcribed and categorised according to themes and sub-themes. Emerging themes and categories were analysed, grouped together, and supported by participants' quotes from the transcribed focus group interviews.

4.2 RESEARCH SETTING AND PARTICIPANTS

The setting and participants were clearly indicated in Chapter 3. The selected school in this study is located in a township in the Tshwane North District. This is the only school whose LoLT is English. This school was selected because of its outstanding performance in the ANA.

Two participants were selected from each Foundation Phase group viz.: Grades 1, 2 and 3. In selecting the teachers, years of experience were not specified. This became a limitation. One Grade 2 teacher had 1 year of experience, with a Bachelor of Science degree in Geology and a Certificate in Education methods. One Grade 1 teacher had a qualification in Further Education and Training specialising in Consumer Studies and 2 years of experience in teaching in the Foundation Phase. Two of the teachers, one in Grade 3 and the other in Grade 1, had 25 years of experience in teaching Foundation Phase. One Grade 2 teacher had mixed experience of 9 years in the Foundation Phase and 2 years of experience in teaching the Intermediate Phase. The last identified teacher was not part of the interviews, however she was observed in class with 60 learners.

The diverse setting in which the researcher collected data from, contributed to the rich insights coming from the teacher experiences in teaching number sense in the Foundation Phase. Data were collected according to Clark and Veale (2018) as it brings out the importance that researchers use their knowledge to extend their thinking in qualitative research. Clark and Veale (2018) further allude to the point that participants' responses depend on how the questions are being posed. Walshaw (2017) indicate that subjectivity is inevitable and becomes imperative in qualitative research following the dynamics of individuals. Within all the identified dynamics in the participating teachers, the descriptions given however contributed to the teachers' experiences teaching number sense in the Foundation Phase. All teachers had their own experience in their situations.

4.3 DESCRIPTION OF THE SEMI-STRUCTURED INTERVIEWS

In the study, teachers were referred to as cases, however the codes used against each were T1, T2, T3, T4, T5 and T6. This is how participants are protected and anonymity was considered. Explanations and permission were sought from the participants where they willingly consented.

I approached the principal of the identified school to seek entry into the Foundation Phase classes to observe and interview teachers in their settings. The teachers who participated were identified by the principal of the school and indicated that “the teachers I am allowing you to participate, are those who teach in the Foundation Phase and are willing to share their experience.” I was then afforded an opportunity to meet with individual teachers. I explained the processes that will be followed for interviews and classroom observation.

I agreed with the participating teachers that I would conduct an individual classroom observation and the interview would be a focused group. The reason is that they were already starting with assessments for the term. I agreed as I could not interfere with the planned programme of the school.

Time was allocated after the contact time to conduct the semi-structured group interviews with the participants. The venue was one of the classes in the Foundation Phase block. Prior to the interviews, the researcher reiterated the ethical issues that were to be considered during the interviews. The anonymity and confidentiality were put to alleviate any uncertainties to the participants. The researcher in that sitting, sought the usage of the audiotape to be used for the purpose of authenticity of the submissions which are going to be important in the reporting process. Notes were also taken during the interview session. All participants agreed to the process and how the research would unfold.

I informed the participants that I would like to hear their experience regarding the teaching of number sense in the Foundation Phase. The participants were willing to share information freely. They were eager to know if I would be able to share this study once it was completed. T3 indicated that “We need training regarding the teaching of mathematics in our school.” I, as a researcher, noted the request on further development which the teachers expressed as a need. This request will form

part of the recommendations in the study. Tsao and Lin (2011) indicate that the interviews are guided conversations than interrogation to the participants. It was evident that when conversations are structured in an interview, participants made efforts to reflect on their own practices and they became honest about their practices. T1 indicated: "Sadly, many of us don't know our CAPS document. We wait for someone to come and tell us what is in the CAPS." T5 agreed when she indicated that "I don't know all the topics that are in the CAPS document." The teacher referred to the topics and concepts as "learning outcomes." The participants were honest about the underutilisation of the CAPS as they are still referring to the scripted lesson plans from an intervention programme which was in the Gauteng Province, Gauteng Primary Mathematics and Languages Strategy (GPLMS).

4.3.1 Profile of participants

4.3.1.1 Teacher 1

Participant one taught the Grade 1 class. She is a fairly young teacher who seemed very relaxed and interacted well with the learners. The number of learners in her class was 43 and manageable. She had two years of experience teaching the Foundation Phase. Her training is at FET Phase and in Consumer studies. She was confident in her teaching and learners seemed to be used to her.

4.3.1.2 Teacher 2

The teacher taught Grade 2 with 46 learners in class and one year of teaching experience. She has her qualification as Bachelor of Science in Geology and studied the methodology certificate to be able to teach. She was more reserved but seemed to want to find more about teaching of number sense and what it meant. Her concern was on how learners learnt. She taught but she saw minimal results. She relied more on the DBE workbooks for her to cover the expected curriculum as per Annual Teaching Plans (ATPs).

4.3.1.3 Teacher 3

The teacher in Grade 2 had 52 learners in class, with nine years of teaching experience in the Foundation Phase and two years the Intermediate Phase. Her qualification is in Primary school teaching and she had an Advanced Certificate in Curriculum Management. She had positive energy in teaching Mathematics in the

Foundation Phase. She was very clear about her love of teaching learners in the Foundation Phase. She was eager to improve her understanding of the CAPS policy.

4.3.1.4 Teacher 4

The teacher had 60 Grade 3 learners. She had a Junior Primary Teachers' Diploma and taught and relevantly placed in the classes she was trained to teach. She furthered her studies in Education Management Advanced Certificate in Education (ACE). The teacher had 25 years of experience teaching in the Foundation Phase. She indicated that she was worried about the large class she was teaching. She reported that she was not able to communicate with all her learners. She voiced her concerns regarding the class size and her inability to reach all the learners due to an overcrowded classroom.

4.3.1.5 Teacher 5

Teacher 5 is a qualified in Senior Phase teacher holding a University diploma. She further studied Educational management and a Bachelor's in Education. She is as well holding an Honours in learner Support. She had 25 years of experience in teaching across the grades in the Foundation Phase. She was trained on the CAPS at its inception which was conducted by District Officials and the Head Office. She was delighted to be teaching in the Foundation Phase. She said that she enjoyed teaching the Grade 1 learners. She indicated that she often consulted the policy where she did not understand what and how to teach.

4.3.1.6 Teacher 6

There were 60 learners in this Grade 3 class. During class observation the teacher indicated that learners were too many. However, there were efforts taken to collect resources for the lesson taught. She is a very relaxed and experienced teacher. Observing her teaching, I noticed that she used concrete resources where learners experimented and tried out the concept of measurement in millilitres. She used containers as objects to teach size and quantity, which captured learners' attention.

4.4 DATA ANALYSIS PROCESS

The researcher used open-ended questions to get an in-depth understanding of the concept of number sense and how it is taught in the Foundation Phase to gain relevant data from participants. The teachers were asked questions regarding their experience in teaching number sense in the Foundation Phase. Questions around the usage of resources in teaching number sense, strategies and methods they applied in teaching number sense were reflected on during the interviews. These questions were designed to obtain information on the application of constructivist principles and the unique ZPD of each learner. It became an opportunity to gain some insight into practices and abilities of teachers to effectively and efficiently share their experiences of how number sense is taught in the Foundation Phase.

After each semi-structured interview conducted, the interview was transcribed directly from the notes that were taken during the interview. The transcription process was done immediately after the interview, to ensure that all the data that were collected and captured correctly were as accurate as possible. As a researcher I filtered through each interview for me to create a holistic picture of the teachers' experiences and practices when teaching number sense in the Foundation Phase classes.

Notes were taken and organised. Themes emerged from the recurring ideas. Similar topics were clustered together and coding was done by using short phrases and colours. The re-curing phrases were then organised into emerging themes that informed the research analysis process. Creswell (2012), indicate the structure which could be developed into both themes and sub-themes. In studying the data, the themes were investigated against the information depicted in the theoretical framework. They were developed and sub-themes are discussed in section 4.5.

4.5 RESEARCH RESULTS

The table below indicates codes attached to the participants according to their cases.

Table 4.1: Coding of participants

PARTICIPANT	CODE
TEACHER 1	T1
TEACHER 2	T2
TEACHER 3	T3
TEACHER 4	T4
TEACHER 5	T5
TEACHER 5	T6

According to Crow and Wiles (2008) it is the responsibility of the researcher to find a way to reassure the participants that information shared would remain completely anonymous.

In progress of data analysis, three major themes emerged. Each theme developed with some sub-themes. These are tabulated in Table 4.2 below. Both the themes and sub-themes assisted with the structure and insight about the data collected.

Table 4.2: Identified themes from the data collected

Themes	Sub-themes
Teachers' understanding of the concept "number sense."	<ul style="list-style-type: none">• Knowledge and understanding of number sense.• Teachers' perceptions towards teaching and learning.
Teachers' experiences in teaching number sense.	<ul style="list-style-type: none">• Planning and preparation for teaching and learning.• Understanding the usage of CAPS as a guiding policy – Curriculum coverage.• Strategies, techniques and methods in teaching number sense.• Differentiated teaching in the Foundation Phase.
Challenges experienced by teachers in teaching number sense.	<ul style="list-style-type: none">• Inadequate support, guidance and training.• Inability to access and interpret policy documents.• Usage of resources.

4.5.1 Theme 1: Teachers understanding of the concept “number sense”

Theme 1 is focused on teachers’ understanding and knowledge of number sense. Questions were posed to the participants such as, “What do you understand by number sense?” The aim of this question was to elicit teacher’s understanding of numbers sense. In the Foundation Phase it is important that teachers have a sound understanding of mathematical concepts before they are introduced to young learners (Aunio & Niemivirta, 2010).

I wanted to know if teachers in the Foundation Phase had sufficient knowledge and understanding of number sense. Early number sense according to Pittalis, Pitta-Pantazi and Christou (2015) is of paramount importance for later Mathematics development.

4.5.1.1 Knowledge and understanding of number sense

According to McLellan (2012) sound knowledge and understanding of number sense in the Foundation Phase are significant for later mathematical competencies. He further indicates that all learners come into the classroom with numerical knowledge. Teachers should be able to identify and develop this knowledge further through appropriate teaching activities to strengthen early number sense. Aunio and Niemivirta (2010) agree that early number sense is of paramount importance for later mathematical development.

During the interview T1 and T2 had very limited knowledge and understanding of number sense. T1 stated:

I teach counting, number identification and names of numbers, but I did not know it was called number sense.

T2 agreed:

This is the first time I am hearing the word ‘number sense.

T3 had some understanding of number sense. She could relate that number sense is the understanding of numbers. She knew that it is important for children to have good understanding of number sense.

T4 indicated:

I attended a workshop where the facilitator introduced number sense to us.

Theme 1 addresses the teachers' insight of number sense as an important concept forming the basis of Mathematics in the Foundation Phase CAPS (2011). The CAPS is the guiding policy expected to be implemented by all teachers teaching Mathematics in the Foundation Phase.

In Chapter 1, paragraph 1.4 concepts are clarified. Number sense is clarified as the basis of what the teacher has to know and understand before she can teach. Content and pedagogical knowledge of teachers has to be shown in planning and preparation for the Mathematics lessons in the Foundation Phase. In teaching, planning and preparation with the guide from the CAPS the teachers have to be able to integrate and know the relationship of content (CAPS, 2011) that relate to learners to cover the expected curriculum to be taught.

T1 explained that:

In my understanding number sense is when learners understand and use numbers around them in their everyday life ... recognition number and the value.

She continued saying:

It is when learners are able to understand the numbers, relationship between all the numbers and getting to know the numbers and understanding them.

T2 stated:

According to me number sense is knowing that numbers are used in everyday life, knowing that everything we do involves the numbers.

She continued that:

To recognize numbers and be able to work with them in the classroom.

T3 indicated that:

... for me number sense is using the number operations, to subtract and add.

T5 added by saying:

In addition, number sense entails ordering and comparing the numbers.

As a subject advisor in the Foundation Phase, I have realised that many teachers have the knowledge to teach concepts and topics prescribed by CAPS, but they do not know the scientific or universal language or vocabulary being used, for example, teachers are teaching number sense in schools, but are unaware that it is called 'number sense'. To ensure that all teachers are fully aware of the nomenclature teachers need to be capacitated.

In answering the question on the understanding of concept number sense, there was an indication from all teachers that they had knowledge of what number sense is to some extent. The participants were able to say what number sense is, however they did not seem convinced. They indicated that number sense was something separate from what they were doing during daily teaching and learning. Even in their explanations they said it entailed usage of numbers in everyday life. T3 had to pause and think for some time on what number sense was. The teachers were not aware that number sense is described in the CAPS.

Further discussions centred on comments on what was meant by ordering and comparing as part of number sense.

T4 said:

Number sense is when learners know and understand numbers around them in their everyday life. It includes understanding of concepts and the value of numbers. Numbers are used in everyday life and not in isolation.

T1 indicated that:

... everything we do involves numbers.

In her teaching in Grade 1, T1 reported that she used pen and board to draw and write. In my understanding, if the learners could have been given some props and objects to manipulate, it was going to be a lesson which would facilitate full understanding. Learners who did not seem to understand what the teacher was writing, continued making noise and the teacher did not attend to them. She

continued with number patterns when others were not conversant with geometric ones.

In T4's class it was evident that learners were responsive and analytical in answering the questions posed to them. Much as the sources used were from the previous year, she was conversant with the content taught. She seemed to be relying much on her experience as she had been teaching 25 years in the Foundation Phase.

Below is a group contribution by teachers on what they understood what number sense is.

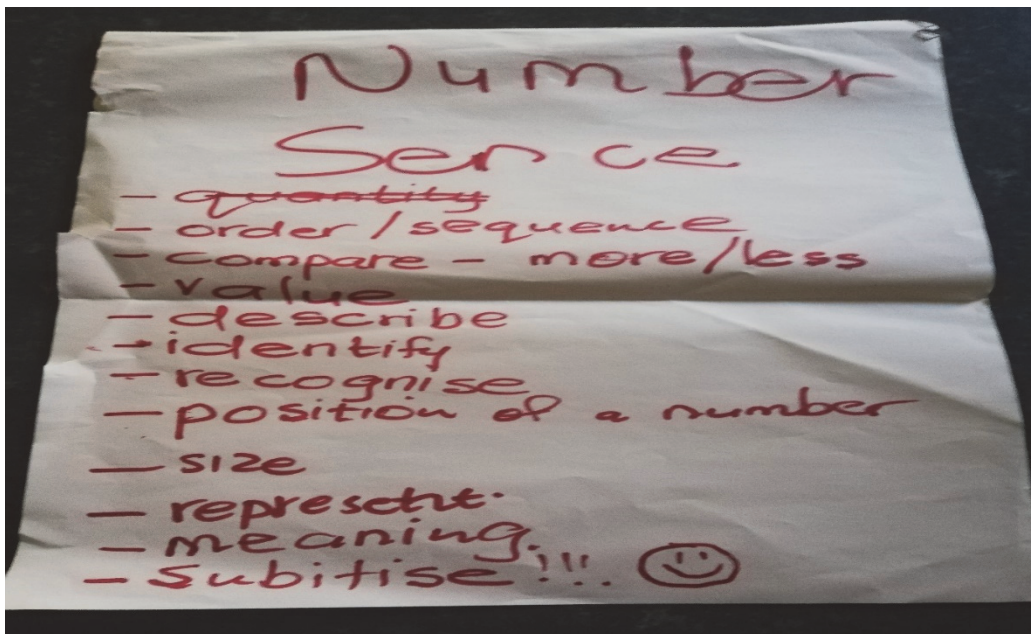


Figure 4.1: Taken from teachers content workshop on: Content Area no. 1 - Number Operations and Relationships

4.5.1.2 Teachers' perceptions towards teaching and learning

Based on the observation process that took place, the teachers' perceptual and understanding of number sense became the focal point. The interpretation and understanding were closely observed.

The purposive teaching of Mathematics as indicated by Mathematics Teaching and Learning Framework, Louie (2018) shows that there are specific pointers to be considered in teaching Mathematics. The Mathematics Teaching and Learning indicated by Baroody (2003) further depicts the three positions considered in

teaching Mathematics for understanding. The first indicated is conceptual understanding, procedural fluency and strategic competence. Venkat and Spaul's (2015) findings established that basic training of teachers should ensure that teachers are conversant with the content knowledge required to teach Mathematics in the Foundation Phase.

Perception of teachers in teaching number sense would be seen in the productive usage of the notional time. T1, T2, T3, T4, T5, T6, taught Mathematics without the usage of decoded lesson plan. The GPLMS lesson plans were followed as they were. The internalisation of skills taught have not shown effect in how the teaching took place. When asking about the lesson plan, T2 indicated that:

I don't have lesson plans from the Department. I try and work out my own lesson plan. They are not delivered as yet.

The teacher was sharing scripted GPLMS lesson plans with the next-door teacher. She worked from the DBE workbooks.

T1 She indicated:

... teacher who prepares the lessons has not given us the complete lesson plan as yet, hence I am using GPLMS.

Asking about the CAPS, she indicated that:

We do not use it regularly as we have the GPLMS.

T3 stated:

I am the one who is preparing mathematics lessons but I have not finished.

She presented me with an empty template of the lesson plan.

We are following the GPLMS.

T4 stated:

We are overwhelmed with the assessment to a level where we cannot prepare.

However, she gave me her own lesson developed from the GPLMS scripted lessons.

You can also see how overcrowded my class is, I cannot reach all the learners.

Grouping towards multiplication was taught. After the learners had drawn the bags, they counted in ones. Counting in groups as a skill was not emphasised. T5's lesson started with a counting rhyme. The lesson was on number names and number symbols in Grade 1. She had number cards that were coloured the same for the number and the symbol. Learners were asked to match the cards. There was one learner who never raised his hand but continuously commented when one had the answer correct. He was aware that the number cards had the same colour as their number symbols. He said, "They see the colour" in his deep voice. The teacher did not give the necessary attention to show that he had found his way of matching the cards. It could have been an opportunity for the teacher to emphasise to the struggling learners that they could identify the cards with colours at the end of the lesson.

It is within the competency of the teacher to realise that teaching concepts and topics and strategies embedded within the CAPS should resonate with them at all levels of teaching number sense in the Foundation Phase. In Chapter 2, Figure 2.2 it is indicated that the teachers' knowledge should inform them to be creative in involving learners in the environment where learning will be reinforced through exposure and realising that Mathematics is found in all spheres of life. They should plan to teach skills that cover all topics in the CAPS to improve learners' understanding of Maths.

4.5.2 Theme 2: Teachers' experiences in teaching number sense

The observations and interviews provided the researcher with insight on how teachers teach number sense and to determine its impact on teaching and learning. During the conversations with teachers regarding their experiences in teaching number sense, some teachers found it difficult to express their experiences about number sense.

4.5.2.1 Planning and preparation for teaching and learning of number sense

A question was posed on planning and preparation of lessons. Participants shared their views with a degree of reluctance. Some of them shied away and looked at each other. Immediately, I sensed that the participants were a bit reluctant to discuss this question. I informed teachers about confidentiality and anonymity. They became comfortable to discuss planning and preparation.

The teachers agreed that they were not always staying together to prepare for learning. T4 indicated that:

... but it is not easy because of the time which we have to cover all our teaching. In the afternoons, we try to catch up on marking and other administrative work where we could be concentrating on preparation for teaching.

T3 who is chosen to prepare the Mathematics lessons added and said:

Hence you see, I do have a file with lesson plan templates, but I seldom have time to complete them.

T1 added:

That is why we were referring you to her, the only thing that assists us is to cover the expected curriculum and GPLMS. With it we only teach and don't have to sit and prepare.

T2 did not contribute to this section and her view was that she was represented by the ones who are responding. She as well told me that she was only using DBE and GPLMS.

Generally, all teachers taught without actual preparation. GPLMS was regarded as a supporting resource, served as complete preparation and planning of teaching and learning. The teachers indicated that they came together at least once at the beginning of each term to remind each other of keeping files to include lesson plans.

The lesson plan booklets were also not found in every class. T2 did not have it when we were observing her class on teaching strategies. She taught from the DBE workbook. Teachers were asked if they were aware of the gaps that GPLMS had

which contributed to making it a resource and not a main working document. Some were aware. It is where the older teachers indicated that they adjusted their lessons and aligned them with both the ATP and the CAPS. The researcher asked once more if the adjustments were noted somewhere so as to refer to them again in the coming year. With reluctance T5 indicated that they noted by writing with a pencil in the booklet.

Teachers acknowledged that, there was a need for them to take planning and preparation seriously. They indicated that these interviews and observations were becoming an eye opener for them to realise the importance of well-planned lessons and preparation thereof. T3 indicated that:

I now see that keeping empty templates does not help.

T4 indicated:

I see that you are worried to be presented with template with no content in them.

The she laughed and blushed. T2 said:

I have been assuming that for the fact that I have GPLMS and DBE workbooks, I will have prepared and planned for learning and teaching.

The researcher indicated the importance of decoding information. Decoding will happen when customised plans and preparation are in place. The creativity of the teacher is often revealed when studying their lesson plans.

Learning and teaching is a process that has to be planned for. Roberts (2016) points out how learning has to be planned for by giving the pointers in Figure 4.2 below.

As a small group teacher, it is going to be important to:



- think for themselves;

- organise and structure their thoughts and ideas;
- vocalise and discuss their views and understandings;
- design learning activities and tasks that require active engagement;
- and
- provide feedback on what learners are doing well and how they can improve.

Figure 4.2: The importance of preparation for teaching number sense (Source: Roberts, 2016)

The figure above, is an indication that planning and preparation is the starting point of learning and teaching. A further indication is the fact that in the construction of meaning, learners should be provided with tools that will assist in making meaning from what they are engaged with and allow self-challenge.

If teachers find it difficult to relate their experiences in teaching number sense, it impacts on the content that is taught. Much is not done on the reflection of what is taught. Learners who did not attain on a particular concept are categorised as learners with a special need before repetition is done to test the actual level of the learners on one-on-one level of teaching in small groups.

The ATPs have components that are to be taught on a daily basis. There is counting for 5 minutes, mental maths for 10 minutes, word sums for 15 minutes and the concept of the day for 30 minutes teaching and 30 minutes for written activities. Some teachers are able to follow the ATP as it is allocated time while others, not seem to have prepared, end up mixing topics (without focused integration depicted in the CAPS) from the various components. In some instances, they do not address the concept as the main topic, but write and teach either mental maths or count for a longer time and leave out the topic of the day. When they have to verify the curriculum covered, there are activities done, however not at the expected level nor taught as expected by policy. T3 pointed out that she has friends who are teachers in the North West Province, who share National Education Collaboration Trust (NECT) lesson plans with her. She further said:

The NECT lesson plans are similar to GPLMS. They are aligned with the CAPS but I have not verified them yet.

The teacher confidently indicated that the NECT lesson plans are aligned with the CAPS and immediately indicated that she did not verify the alignment she was referring to. However, she kept on saying the lessons were well aligned to the CAPS and DBE workbooks.

T4 stated:

You know madam, we as teachers sometimes are not honest to ourselves. When GPLMS was here, we complained about the workload that has increased despite that there are lessons prepared for us.

Teachers indicated that they planned lessons to be taught. They reported that sometimes they ended up not sitting for such meetings, but because they did not really know what to do, their practice collapsed. Participants maintained that DHs were also on the same level as they; they do not give sufficient guidance on what and how to execute the planning and preparation for learning.

4.5.2.2 Implementing CAPS as a guiding policy

Participants were asked if they used CAPS as a guiding policy document. Most participants agreed that they implemented the CAPS. In the six classes where observations were conducted, the policy documents were not available, however in conversation the teachers indicated that they had the policy documents in their closets. Usage as a guide for preparation for learning and teaching was not evident. The teachers indicated that it was not necessary for them to have policies at hand as they are using the scripted GPLMS lessons. T1 said:

... in GPLMS every step is being prepared for us, so in case we use the policy we might fall off track.

T4 said:

I do use it in some instance where there is a need for fresh ideas.

The teacher, who indicated that she referred to only Grade 1, was unable to name the grade overview. T3 stated that:

I would love to know how to use the CAPS, but when training was done, I was in the Intermediate Phase. The intermediate policy document for

Mathematics is very small and not intimidating as this one in the Foundation Phase.

T4 added while the other was still talking by saying:

We are willing to assist.

Two participants indicated that they were trained on how to use the CAPS. The teachers with less than four years of experience indicated that they were trained on sight by their colleagues. Asking the teachers about how they used the CAPS, T5 submitted that:

CAPS give clarity on how to tackle concepts, in most cases. It tells you about number and concepts and what you can do in a grade in this term.

The researcher asked:

What do we call that part of the policy telling us about the concepts per grade in a term?

T5 said:

In the first pages 'ke di learning outcomes' (meaning; they are learning outcomes), to be done in terms 1, 2, 3, 4.

The participants laughed. I had to give information that part is called “grade over view.”

T3 opined:

We have to go and sit on our Bibles (CAPS policy documents).

In contradiction the teacher indicated that she looked for content and only when she struggled.

This was a general acknowledgement that the needed to re-visit the CAPS document. The CAPS is seldom used to prepare and plan for learning and teaching. There is a need for the teachers to be re-trained each term. The subject advisors should take it upon themselves to conduct orientation sessions with new teachers and benchmark on their level of performance before teachers are frustrated with the situations they find themselves in. On the other hand, the teachers who are long in

service have to be encouraged not to lose the long learnt basic teaching strategies when new projects are introduced to schools. In this case, the teachers were derailed by Gauteng Primary Languages and Mathematics Strategy (GPLMS). They hung on GPLMS and the good practices they applied before GPLMS were abundant.

4.5.2.3 Strategies, techniques and methods in teaching number sense

One of the questions posed to the participants were strategies and techniques they used in the teaching of number sense. I wanted to know if teachers had knowledge and understanding of the different strategies and techniques used in the teaching of number sense in the Foundation Phase.

In Chapter 2, paragraph 2.7, the strategies to improve the teaching of number sense in the Foundation Phase were addressed. Teachers were not able to point them out when asked what strategies were applied in their teaching. They reported that they used the strategies not knowing that they are even embedded in the CAPS for them to teach. T2 did not know that when she used the number line and counted she was implementing one of the strategies in counting as learners were adding.

There were workshops that the teachers mentioned they attended, however there was no evidence of implementation thereof. The researcher asked for manuals from the workshops. Only one was brought on 'calculation strategies'. The manual had many different strategies that could be used to improve teaching. The teachers who attended the workshop, indicated that they never had time to sit together and gave feedback to others.

T4 said:

Hence, we find ourselves in our own silos, making mistakes, and we only discover we are making mistakes when we are visited by curriculum specialist from outside.

Counting in all classes was rote counting. It was not focused. It seemed that time allocated for counting, was used by teachers as classroom management time. Where the ATP indicated that "Count in 1s from 1-100 – learners would count for 30 minutes." With my experience as a subject advisor, the process made me

understand why learners could do rote counting and when they had to manipulate objects, they indicated non-existence and understanding of numbers and its “how-much-ness” of the numbers which translates to number sense.

Teachers indicated the workshops they attended in line with number sense. T5 while teaching number names and number symbols, had resources on her table that were relevant to the topic however not used. When I asked what she was doing with them, she indicated:

They are from last year hence I am not using them and I will make new ones for this year.

I had to encourage T3 to say something as she was very quiet.

I continued asking the teachers if they were trained on strategies. T5:

We attended problem solving “nqaa” (unbelievable exclamation).

When discussing the origin of their teaching strategies T3 posited:

Some I attended some I learnt from colleagues.

When they were asked if they collected resources to teach mathematics strategies, T5 indicated that:

We do collect resources relevant to the topic.

During observations I found T5 with old resources in place which she could not use. I appreciated that T5 had the number symbols and number names flashcards.

When responding to the question on strategies used during the teaching of number sense, T1 indicated that:

Songs, hands and counters were used.

She ended there and did not elaborate while it was expected that she gave relevant examples thereof. T2 and T3 did not contribute towards the strategies used in the teaching of number sense in their classes and they indicated by nodding heads that they agreed with what others were saying.

T4 indicated that:

Mental Maths is a strategy and reshuffling of number cards, building numbers using number cards.

T5:

... number line starting from concrete to abstract as well as counting the body parts, eyes, ears, fingers

When they were asked if they were trained on strategies, T1 and T2 answered in single words saying “trained”. T3 said: “Some and some learnt from colleagues.” T4 said: “some were our own innovations. I was trained on “problem solving and patterns as well.”

The analysis made by Ramnarain, Thomson, Mukwevho, Grussendorff and Mchunu (2015) hold the position that CAPS do not mention a kind of the teacher we are looking for and does not cover the strategies that the teachers have to implement in teaching and learning. Nevertheless, CAPS (2011) states strategies within the following aims expected of Content Area: 1 topic; 1.12 as follows:

Use the following techniques when performing calculations:

- drawing or concrete apparatus e.g. counters;
- building up and breaking down numbers;
- doubling and halving; and
- using number lines supported by concrete apparatus and rounding off in tens.

4.5.2.4 Differentiated teaching in the Foundation Phase

I wanted to know if teachers planned for differentiated teaching and learning in their class. I asked the participants if they applied the principles of differentiated teaching and learning in their class.

Wium and Louw (2011) opine that the teachers’ strengths should be seen in how they vary their practices during learning and teaching. CAPS (2011) illustrates that learners with barriers would be best supported in the differentiated activities and in small groups. Ramollo (2014) in her findings, explains that teachers appreciated the strategies they were taught in their training which gave them an opportunity to reflect

on their teaching. The strategies if implemented and known to teachers, will definitely challenge them to become innovative in their teaching and they will be challenged to apply them in small groups. This is supported by Roberts (2016) that in constructivism, which is directing this study, small group learning is at the helm where learners are exposed to thinking at a higher level assisted by a more knowledgeable one.

In all six (6) classes, learners were taught in one method, despite the number that they were in classes. T4 as I asked how about grouping the learners for her to reach them, she indicated:

It is difficult to teach in small groups because of the large number of learners. You see, those at the back play, knowing that I cannot reach them, and they don't even write when they are supposed to.

T6 said:

Madam, these learners are many. Even when I ask them to bring things from home that we can use to teach, they don't, and it becomes a problem when I use few props with many learners.

In all classes, there were learners who would talk while the teacher was teaching and the teachers would continue without emphasising the importance of concentrating.

T2 opined:

When you try to discipline them they just ignore you or even tell you they are going to tell their parents.

The manner in which the teachers submitted their contributions towards the questions, did not have any indication that they are aware that it is expected of them by the CAPS to teach in small groups for the purpose of reaching all learners as per their abilities. Striving to occupy each learner in small groups, with differentiated activities, improves discipline in class.

There were limited representational activities in the classes where learners would be able to make connections of how learning is taking place. The teachers used

chalk-and-board method than the objects for more exploration to make connections and representations of numbers.

The teachers' responsibility to teach in small groups, calls them to prepare questions to be asked on the content, plan and collect resources for different groups to ensure focused and constructive learning.

In most cases learners who are unruly are the ones who do not understand what is taught. Small groups would take learners with same abilities put them together and reinforce concept at a different level, while others who grasped the content would be given work relevant to their level of performance on the concept taught.

The teacher in Grade 1 gave learners 10 sums and explained that the first three were aimed at the lower performing learners; the next three were aimed at average learners and the last four at high performers. It made so much sense that the teacher had planned constructively and managed to differentiate work according to learner abilities.

4.5.3 Theme 3: Challenges experienced by teachers in teaching number sense

There are always concerns from teachers about teaching within the environments they find themselves in. When they were asked what challenges they experienced, their responses presented around both content knowledge and pedagogical knowledge in teaching number sense.

Theme 3 is also referred to in chapter 2, paragraph 2.6 where teachers' challenges are addressed as impediments to teaching number sense in the Foundation Phase. In addition, Venkat and Askew (2019) illustrate that teachers reveal different levels in their understanding of content knowledge. In paragraph 2.1.6, CAPS (2011) point out the characteristics of an envisaged teacher teaching number sense in the Foundation Phase focusing on the content knowledge they possess.

4.5.3.1 Inadequate support, guidance and training

Teachers' attitudes determine the practices in teaching and learning as Kriek and Grayson (2009) indicate. Striving to attend to the observed challenges, they developed a model on Holistic Professional Development, where content

knowledge, teaching approaches, and professional attitudes were integrated. Similarly, pre-service teacher content knowledge was tested through the Primary Teacher Development Project where Bowie, Venkat and Askew (SAARMSTE, 2019) identified the gaps through a project in supporting teachers to acquire content knowledge. The findings within the project revealed that there is a need to provide insight into processes and procedures to be applied in Mathematics teaching.

The teachers indicated that the subject advisors do support them, however they come after a long time. They explained that they sit as grade in the school and demonstrate to each other on how to teach concepts. After workshops they regrouped again and shared information. T2 indicated that the topic “time” was the one she remembered to be supported on. The support was on-site workshop.

In this study, the inadequate support, guidance and training difficulty in accessing the policy documents, were influenced by the teachers’ attitudes of translating the content they are trained on further into their classrooms. There are Professional Learning Communities encouraged by the DBE (2011) where teachers have an opportunity to learn and support each other on content knowledge. Teachers have to take the initiative to have good practices towards sharing approaches which will lead to improved processes of learning and teaching.

The teachers concurred that they attended workshops in line with number sense. They mentioned number line as one amongst others. They could not mention all workshops attended. T2 reported that she could not remember the workshop but she attended. T3 did not indicate any workshop she attended.

Teachers who are found in the school are holding vast and different qualifications that are not relevant to Foundation Phase. In that, there is a huge need for development and support of these teachers to understand relevant teaching methods applied in the Foundation Phase as a basis for all learning. Paragraph 2.6.2.4 indicates that it is the responsibility of whole school leadership to support the teachers. In most instances, SMT leave the whole responsibility to the DH. According to the ELRC document, the workload of the Foundation Phase DH gives only 2% of managerial time to the DH, in reality is that they are already overwhelmed by being full-time teachers. The support envisaged is to work towards the common

aim (DBE, 2012) in education to attain the improved results where learners leave school having acquired the relevant skills.

The DH, sometimes they only attached signatures on the sampled learners' books without having verified the actual activities done. T2 indicated that:

The knowledge you are sharing with us is vital, especially on how CAPS is packaged. This kind of information we really need and it puts us on our toes to know our content at all times. We appreciate that you came to do this in our school. We will consult with you to assist us when we will be doing our own studies.

4.5.3.2 Inability to access and interpret policy documents

When the Revised National Curriculum Statement (2011) was repackaged into the CAPS all teachers were taken on board to be re-trained. Each teacher was allocated policies in all subjects.

For learners to achieve the above envisaged aims, a teacher must be in the class with a focused plan for the learning environment. Both teacher and learner creativity and innovations should be displayed in the learning process.

T2 and T5 are the ones who were trained in 2011.

T2 said:

Trained, however I was in the Intermediate Phase. But CAPS being CAPS with its progression, I made sure I know what to teach in the Foundation Phase.

T5 posited:

While we needed to know CAPS better, then GPLMS came. We were monitored by coaches and ended up seeing no need to focus on the policy document.

Both T2 and T5 concurred to say:

Maybe that is why we are struggling to use the CAPS now (laughing).

The National Curriculum Statement Grades R-12 aims to produce learners that are able to:

- identify and solve problems and make decisions using critical and creative thinking;
- work effectively as individuals and with others as members of a team;
- organise and manage themselves and their activities responsibly and effectively;
- collect, analyse, organise and critically evaluate information;
- communicate effectively using visual, symbolic and/or language skills in various modes;
- use science and technology effectively and critically showing responsibility towards the environment and the health of others; and
- demonstrate an understanding of the world as a set of related systems by recognising that problem-solving contexts do not exist in isolation.

There was a lack of knowledge and understanding among participants. There is a great need of “quality of practice” indicated by the Education Alliance (2006).

4.5.3.3 Usage of resources

Resources are the first level to consider when planning teaching. They should be consciously chosen. Every topic should be introduced with concrete resources. These concrete resources are the basis of elucidating knowledge. Learning takes place by first seeing and touching. There are three levels that are important to teach learners in the Foundation Phase, starting from using the concrete object especially their own bodies to learn Mathematics. They can count in groups of two from their bodies before they actually use objects. Then they will move to semi-concrete/abstract and lastly to the pen and paper which involves abstract thinking to represent what they have learnt DBE (2011).

Table 4.3: Three levels in the Foundation Phase

Concrete stage	Representational stage	Abstract stage
A mathematical concept is introduced with manipulatives; students explore the concept using the manipulatives in purposeful activity.	A mathematical concept is represented using pictures of some sort to stand for the concrete objects (the manipulatives) of the previous stage; students demonstrate how they can both visualise and communicate the concept at a pictorial level.	Mathematical symbols (numerals, operation signs, etc.) are used to express the concept in symbolic language; students demonstrate their understanding of the mathematical concept using the language of mathematics.

(Source: CAPS, 2011)

Resources are categorised by different levels of teaching; however, the three stages have to be implemented consistently through each topic or concept taught. Chapter 2 addresses the resources that DBE have continuously given support to schools with the aim of improving subject knowledge for both learners and teachers. The support comes as kits with resources on Mathematics.

The DBE has availed the Rainbow Workbooks (2012) to serve as a resource for teachers.

T 5 said:

I think the DBE activities differ and some of the topics do not correlate. I sometimes want to take activities from other terms, however when the officials come they want us to use only for the current term. We use them for three days.

T2 said:

They are user friendly the only thing is marking which is too much.

T4 said:

Madam when the officials come.

T3 replied:

We raised our concerns.

T4 commented:

But they were never attended to.

T5 said:

They even count the number of activities from the DBE but not towards curriculum coverage.

T2 said:

Foundation phase learners are curious and very interested. When you just write a number, they raise hands to answer.

T1 commented:

Learners can grasp to understand more actually what you are teaching about, they learn by seeing. If they see they are going to understand better.

T5 said:

To add, they have to touch so that they remember what they are doing in class. They don't forget easily. They remember what is taught.

There are resources to support teaching of number sense, however, the teachers were not using the resources as they were intended. There were abacuses both for learners and a big one for the teacher, but they were not seen used during the observation. There are DBE workbooks which are meant to reinforce the concepts and topics taught. The teachers used them during the initial teaching, before they have introduced the topic with concretes. Learners did classwork using the worksheets from the DBE workbook.

The ZPD indicates that the first level is where learners have to be shown "how to do it." The showing cannot happen without any manipulatives in Mathematics. Moyer (2001) indicates that the manipulatives are both tactile and visual objects which learners have to be exposed to in learning Mathematics in the Foundation Phase. Usage of objects cannot be undermined in any lesson that is introduced in teaching mathematics to the learners in the Foundation Phase for them to have perceptual mathematical skills.

Teachers agreed that they did know how important resources are in teaching Mathematics. T4 pointed out that it is expensive to buy resources to be used by 60 learners. The Mathematics kits that are sent to school by the provincial and national departments do not cater for the whole class of 60. T3 on the other hand mentioned that there was no enough space where the learners could use to explore the

resources. It is how they sometimes end up not using them. They gather dust under the tables. It is very difficult to implement the CAPS as expected in a large class.

T2 said:

It is as very difficult to control learners not to take resources home. They steal them. For instance, once a piece of a puzzle is lost it becomes useless.

T1 with 45 learners indicated that she took them to the table and taught them in small groups especially those who were struggling. The learners learnt better when they were able to see and touch the resources.

Teachers said that the department provided them with maths tool kits, but they did not know how to use these resources. T4 opined that in their district they had only one Mathematics facilitator. She said:

I think she is not managing to work on her own with over a hundred of schools. She has to go to all the circuits. We are really suffering that we do not get adequate support we need from the District officials.

T3 on the other hand said the District official guided them and thought that they should work in Professional Learning Communities so that they could share good practices. She said:

I think this is the forum that we can use to assist ourselves to use the resources. We are causing the department to have fruitless expenditure.

T3 expressed the wish to be assisted on how to use the resources. In instances where the person who distributed the sources did the mediation, we were so many that we could not see what she was doing.

T5:

I agree that we have to remain after school some days to mediate and ask those who are conversant with a particular resource to demonstrate for us. On our own or waiting for the subject advisor, we will never win nor improve in our teaching of mathematics.

T2 said:

I don't use resources because I don't have money to buy.

I endeavoured to inform the teachers that it is not necessary for them to buy resources, as they can make their own, collect bottle tops, use seeds from the environment, collect stones, leaves and many more props. Sending learners to collect, becomes another integrated activity to use fine motor skills and for learners to discover what is in their environment.

T5 said:

I always ask my children to bring beads and buttons from home for counting. It is not only counting that be taught with objects. All topics within the CAPs can be taught with whatever that is brought by learners. Again, integration of concepts is what the CAPS indicated clearly.

T4 said:

During art lessons in Life skills we paint stones in different colours, and we use these for counting and sorting during Maths lesson. Improvisation is expected from the teachers in the Foundation phase.

T3 commented:

I share resources with my colleagues; each class has a box of resources and we all share even if others leave before we really prepare and share in a school-based PLC. We have decided to sit as a phase, because we really discovered that we need each other's strengths to build a strong phase and to improve our results.

T1:

Grade 1 learners steal resources, and we have to find a way of checking daily, this can be emphasised during packing up time or classroom management time. Rules have to be drilled to learners so that they internalise and know that they need to play and learn again with the toys. The parents should also be made aware that when learners bring school props home, it is their responsibility to tell them to take them back to school. This will contribute to ethical behaviour for our learners which are so much needed in our country at this point in time.

According to Hensley-Pipkin (2015) teachers indicated that there are following gains when manipulatives are being used within the physical environment of learning and teaching:

- verbalising mathematical thinking;
- discussing mathematical ideas and concepts;
- relating real-world situations to mathematical symbolism;
- working collaboratively;
- thinking divergently to find a variety of ways to solve problems;
- expressing problems and solutions using a variety of mathematical symbols;
- making presentations;
- taking ownership of their learning experiences; and
- gaining confidence in their abilities to find solutions to mathematical problems using methods that they come up with themselves without relying on directions from the teacher.

The above-mentioned strengthen the observation that all concepts should be introduced by using concrete resources for learners to internalise knowledge.

Table 4.4: Depicts the teachers' knowledge and understanding of number sense within CAPS

CAPS	T1	T2	T3	T4	T5	T6
Weighting of content area no. 1 per grade					✓	n/a
Usage of CAPS					✓	n/a
Where number sense is depicted	✓	✓			✓	n/a
Mathematical skills taught	✓	✓	✓	✓	✓	✓

Participants realised that they were not conversant with the CAPS as shown in the above table. Weighting of content area one was highlighted because it is where number sense is shown. Participants were not certain which grade is weighted and what percentage. It was T5 who mentioned 65% in Grade 1. She realised it after I had given clues that weighting is per grade. Refer to Chapter 2 (Table 2.1).

It is evident that the teachers did not make links of what they taught to what is found in the Policy as the main document to be used before GPLMS and Annual Teaching Plans (ATPs). There are topics in the ATPs that only puts a concept and does not provide support on how and what to teach. If the teacher does not verify and link

the ATP with the Policy, it creates the perception that there could be topics that are not covered according to the expected level in the CAPS.

GPLMS was mainstreamed in Gauteng as it was a project. It had its flows, hence it had to be used with reference to the CAPS. Some of the flows in GPLMS were lower number ranges in grades and terms of the year. An example: Grade 3 term 1, week 1's concept is "number names and number symbols" together with "ordinals." GPLMS in week 1 addresses "numbers 0-99, place value to 99, compare and order numbers to 99 and numbers between 200-300." If teachers are only following GPLMS they will be left behind in one way or the other.

Participants all agreed that they used the GPLMS and ATPs. In fact, both the documents were developed from the CAPS and teachers are not able to relate them. Tsao and Lin (2011) concur that for a long-time researcher concentrated on learner performance and neglected teacher knowledge of content they were teaching. They furthermore pointed out the misapplication of strategies and teachers' understanding of Mathematics concepts.

In one of the classes during the planned classroom support visit, the topic of the week was on 3D objects. The teacher had a box and a ball. When she explained the objects, she threw the box on the floor and asked: "What is it doing?" One learner took it and slides the box and the teacher told him to bring back and threw it again. She said "the box is rolling." The same learner disagreed shaking his head. The teacher became angry with the child. The teacher took the ball and threw it on the floor and told learners that the box was sliding.

In my experience as a subject advisor, I have amongst many, this example to share. My conscience made me ask to co-teach with the teacher. The boy who understood the concept came to me and explained "nna ne ke ntse ke itse" meaning "I have been long knowing that." There was relief and confidence on the learner's face. There is a need for teachers to prepare before going to class. There are learners who are intelligent who need to be respected and be prepared for through planning and preparation.

4.6 CONCLUSION

In summary it can be said that resources existed at the schools but teachers reported that they were not enough which caused a problem as learners fought to be afforded a chance to use the props. It was also reported that teachers were not fully conversant with CAPS and relied on the GPLMS for guidance. Furthermore, it surfaced that teachers did not always listen well to what students were trying to share and just described them, maybe because of the overcrowded classroom that had to be controlled. The next chapter deals with the summaries and recommendations.

5. CHAPTER 5: INTERPRETATION OF RESEARCH FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

The main focus of Chapter 4 was on findings that emerged from the data collected. The themes were developed and the sub-themes also emerged. The process allowed the researcher to re-organise data Maree (2016) through consideration of axial coding. The focal point of the study was on the teachers' views on how they understood the concept number sense in their teaching experiences. Maree (2016) indicates that fluidity of data analysis provides the researcher an opportunity to go forth and back in process, however be able to have a summary of data collected. Nieuwenhuis (2007) asserts that the researcher needs to acquire an analytical understanding of the phenomenon investigated.

Chapter 5 covers the interpretation and an in-depth understanding of the research findings. Chapter 2 which is the literature review gave relevant support on the experiences and understanding of teachers' teaching of number sense in the Foundation Phase. Findings to answer the research questions that guided the study (see Chapter 1), are covered next.

5.1.1 Primary question

- How do teachers experience the teaching of number sense in the Foundation Phase?

Teachers were not fully aware of what the meaning of number sense was and they had diverse opinions on it. They relied heavily on the GPLMS material and were not fully informed about the CAPS document. They also relied on the support of the HOD which was also not always possible because of her workload. The overcrowded classrooms also made it difficult to teach. Teachers were also not fully informed about the various divisions found in number sense and just thought it was all about adding and subtraction. They also did not all use the abacus available in class when teaching. Number sense was not linked with everyday examples from the environment.

5.1.2 Secondary questions:

- What strategies and methods do Foundation Phase teachers use to teach number sense in the early grades?

Teachers used the learners' bodies which helped a great deal but difficulty arose when they had to move to the abstract part of teaching Maths. They had too many learners in the classroom and they also did not fully use the constructivist approach of involving group work effectively due to the large numbers. Group-work is a strategy that could emphasise learning and teaching. However, group-work could not be implemented due to large classes.

- What kind of support do teachers receive to strengthen their teaching of number sense in Foundation Phase?

Workshops were held, but it was not always possible to follow what was taught due to the large number of teachers who attended. It emerged that they needed more input from the HOD and the DBE with regard to the use of resources supplied. They also needed enough resources to accommodate all learners.

5.2 THEMES AND SUB-THEMES EMERGING FROM THE DATA ANALYSIS

Findings from the data collected validated the existing research and literature. There was a correlation between findings and the presented literature. The themes and sub-themes allowed reorganisation of data to arrive at refined recommendations towards the themes and sub-themes.

In understanding the findings, the researcher used the themes that were formulated in Chapter 4 to clarify the interrelatedness of data collected intending to link both the teachers' experiences and understanding of number sense teaching in the Foundation Phase. The research questions were verified and answers were sought through the findings. Summary and recommendations are presented next.

Table 5.1: Summary and recommendations

Category	Author and year	Existing knowledge	Interpretive discussion
Theme 1: Teachers' understanding of the concept "number sense"			
1.1 Knowledge and understanding of number sense through basic perceptual skills	Burr, Anobile and Arrighi (2017)	Rapid estimation of numbers is being related with the existence of number sense. The understanding of numbers comes through the emergence of discrimination of numbers through numerosity. Discrimination is a natural and basic perceptual skill in Mathematics.	The participants took time to respond to the question of what number sense entailed, which resulted in a view of number sense as a concept they do not deal with life on a daily basis when teaching Mathematics in the Foundation Phase. In answering the question on understanding of number sense, there was no indication of perceptual skills.
	Naudé and Meier (2018)	They explained number sense as an everyday story solving money problems around them.	
	DBE (2011)	The DBE document explains it in terms of very basic counting and provides information on the relationship that exists between objects and symbols. Real-life examples are emphasised.	
1.2 Teachers' perceptions on teaching and learning of number sense	Tsao and Lin (2011)	According to these authors teachers did not have a clear understanding of number sense, and they could not apply the teaching strategies to the expected level. Mis-application of number sense influences the	Participants had a level of understanding of number sense as a concept. There is a need of support to teachers to know that they have to take charge of their own teaching practices. They need to be aware that they are being given a huge responsibility of teaching the learners Mathematics. There is limited creativity within teaching number

Category	Author and year	Existing knowledge	Interpretive discussion
		performance in early grade Mathematics and poor performance was observed. Researchers focused on poor performance but neglected the teachers' understanding and practices regarding number sense.	sense as the teachers are using the scripted lesson plans as the main document. They have to fully align the ATP with the scripted lessons as well as the DBE workbook for improved achievement. The teachers need to know that they are teaching and learners learn to acquire knowledge in their own way. Teachers have to adjust their perception of maths and strive to focus on learner attainment.
	Kofa (2017)	Teachers' perceptions in teaching and their teaching methods are found not to be very clear in highly regarded schools.	



Theme 2: Teachers' experiences in teaching number sense

2.1 Planning and preparation for teaching and learning	Burns (2019)	Preparation and planning for a lesson are an essential and initial step to attend to before getting into class. There has to be research done around the topic to be taught prior teaching. Resources have to be collected and tried out by the teacher in advance. Questions were prepared and tried out by the teacher.	All participants alluded to the fact that there are individual teachers amongst them who are preparing lessons for them per grade. I requested for lesson plans and preparation, templates of lesson plans that were presented but they were incomplete. During that period, they were still awaiting the responsible teacher's dissemination of the prepared lessons. The teacher who had to prepare was amongst the participants and indicated that she had not completed the lessons as she had a big class to manage.
--	--------------	---	---

Category	Author and year	Existing knowledge	Interpretive discussion
2.2 Understanding the usage of CAPS as a guiding policy - Curriculum coverage	CAPS (2011)	CAPS highlight differentiation. Learners are performing at different levels; hence teachers have to differentiate teaching according to abilities. Small groups will give learners an opportunity to learn both orally and practically with concrete resources in place. In this session, learners will be exposed to strategies and topics imperative to understanding number sense. Guidance is depicted in the policy document where rotation is indicated on how to occupy learners in differentiated activities and according to their abilities.	The CAPS was not visible in all classes of the participants. Regarding the usage, the teachers indicated they used both the ATP and the GPLMS scripted lesson plans. Teaching occurred only at whole class level. Learners who progressed slowly or were at risk were taught with all other learners and on the same level. T2 used the number of the day strategy. She used it at the level of mental Mathematics only. She addressed a number before and number after. The researcher's anticipation was that the number of the day would be used in different ways for the learners to see the flexibility and the fluidity of the number for them to be able to make own understanding of how numbers work. The number could be divided, and put on number sentences to add and subtract, estimate in comparison with other numbers. Furthermore, it could be repeated in multiplication as well as measuring.
	English (2002)	The grouping of learners according to their abilities, allows the teacher to teach in a small group where she can teach and intervene immediately by giving attention to individual learners in a group.	
	Shumway (2011)	These groups are not supposed to be permanent. Teaching of number sense becomes effective if numbers are integrated into sensory play. Learners will have an opportunity to match number symbols with number names.	

Category	Author and year	Existing knowledge	Interpretive discussion
			Group work was not effectively done.
2.3 Strategies, techniques and methods in teaching number sense	CAPS (2011)	<p>Throughout the depicted topics in the CAPS, there are skills attached which learners are expected to know by the end of teaching and learning of a particular topic.</p> <p>Content area 1, addresses the number sense knowledge and understanding. Examples thereof are counting in groups, learning all calculation strategies and using the basic operations on a number line, sorting according to attributes which emphasise the perceptual skills in the basic understanding of number sense.</p>	<p>The participants used the strategies that they were conversant with. The fact that they were dependent on the scripted lessons gave rise to such an interpretation. The scripted lessons were to be used alongside the strategies and methods that are found in the CAPS document.</p> <p>The importance of number sense can be realised if the teachers teach the components of the ATP with the background of knowing the effect of each component in the building towards number sense knowledge and understanding.</p> <p>Learners should have worked in groups where they are given an opportunity to contribute their understanding of content taught.</p>
	Devlin (2017)	<p>Representation of numbers to understand mathematics applying efficient strategies.</p> <p>It is confirmed that teachers have to know how to model computing methods. The teachers' skill of recording numbers differently in solving problems, exposes learners to be able to develop more strategies of their own which teachers may have not considered would come from the learners.</p>	

Category	Author and year	Existing knowledge	Interpretive discussion
			<p>It was found that teachers were swamped by the overcrowded classrooms and could not properly listen to the learners' answers.</p>
	<p>Hensley-Pipkin (2015)</p>	<p>Mental maths is a strategy to understand number relations. Allowing learners to work in their groups to discuss own computing strategies, helps them to establish their own thinking and evaluate their approaches.</p> <p>The numerical problems with more than one possible answer, exposes learners to more opportunities to experience learners' diverse, numerical and independent reasoning.</p> <p>Estimation as a strategy that allows learners to make approximations in their everyday lives. The teachers should be able to question learners and how they came about the answers they are giving.</p>	<p>In our participants' classes, the teachers told learners what to do instead of probing knowledge that could be possessed by the learners.</p> <p>Critical reasoning of learners was not being challenged by the methods and strategies that the teachers employed in the teaching of number sense in the Foundation Phase.</p> <p>The concrete resources that were there were neither exposed to the learners to explore in working out word sums and solving problems nor seeing the connections and representations necessary thereof.</p>

Category	Author and year	Existing knowledge	Interpretive discussion
		<p>The teacher that was interviewed indicated that the resources in her class were consciously chosen and aligned with learning and teaching.</p> <p>The teacher that was interviewed indicated that the resources in her class were consciously chosen and aligned with learning and teaching.</p> <p>The resources are aligned with the strategies and methods that are going to be applied for a planned lesson.</p>	<p>Planning for learning should include collection of relevant resources with which learners will acquire knowledge by using them.</p> <p>Preparation includes teacher preparedness to make efforts to understand fully what they are going to teach.</p>
<p>2.4 Differentiated teaching in the Foundation Phase</p>	<p>Hensley-Pipkin (2015)</p>	 <p>Some learners can learn from the concretes on the table above.</p>  <p>At this station, learners who have touched the concretes can move to as the second stage of representational level.</p>	<p>Learning has neither shown any differentiation according to learners' abilities nor differentiated planned activities.</p> <p>Even in a big class the learners can visit a particular table where they can come into contact with the teacher at a close range.</p> <p>The topics from the ATP are treated for the whole week, so a class of 60 learners can form a group along the teachers' large table.</p> <p>There are verandas which could be constructively used to alleviate the congestion that is found in classes.</p> <p>These activities can be planned and all classes</p>

Category	Author and year	Existing knowledge	Interpretive discussion
			rotate through a managed plan.
Theme 3: Challenges experienced by teachers in teaching number sense			
3.1 Support, guidance and training from the Departmental Heads, School Management Team and District Officials	CAPS (2011)	What happens during Mathematics lesson per day, is understood as a period. The whole class activities, small group teaching activities and the independent activities are the main components of the daily classroom teaching. This is the process that has to take place and be managed by Departmental Head, School Management Team and District Officials.	Teaching took place only at the whole class level activities. Mental maths in T3 class was taught as the concept of the day. The written activity was done from the DBE workbook immediately after mental mathematics were taught. T1 showed that she was not prepared for lessons. While the learners were counting, she was searching for resources in the cupboard.
	ELRC (2008)	Class size, learner: teacher ratio, average teacher contact periods, average teacher load it sets as the norm Inclusive education will have the effect of increasing or decreasing teacher demand.	She should have planned a lesson before time. Notional time was not adhered to. The other teachers would call the participant out of class discussing in regard to other issues during the teaching and learning time.
	Education and Labour Relations Council (ELRC, 2008)	The duties and responsibilities of the HOD are tabulated in the ELRC document.	The admin clerk also came to fetch some administrative documents during the period of learning and teaching.
	Education and Labour Relations Council (ELRC, 2008)	The duties and responsibilities of the departmental head are tabulated in the ELRC document.	Both the Grade 3 classes had more than 50 learners. It was observed and evident that teachers could not reach the learners as expected. Inclusivity could not be

Category	Author and year	Existing knowledge	Interpretive discussion
	(ELRC, 2008)	<p>There should be specialisation in teaching the Foundation Phase. Even when there is no specific specialisation per subject, the teachers teaching Foundation Phase are expected to be trained for Foundation Phase qualification for them to be productive and conversant with the expected content.</p>	<p>implemented as the teachers are in a limited situation of forming small groups. Despite the large classes, pens were checked when learners had to write and expected planning prior teaching is not adhered to. It took some time for the T1 to give sharpened pens to the learners.</p> <p>The HOD also had to take care of her class as she is full time teacher in the Foundation Phase.</p> <p>The District officials due to the competing priorities were not regular and could not follow up immediately on the findings in the previous visit. The improvement plans for the school must be comprehensive to show plan that the management have in supporting teachers to implement curriculum.</p>
	Education and Labour Relations Council (ELRC, 2008)	<p>The duties and responsibilities of the departmental head are tabulated in the ELRC document.</p>	<p>Teachers indicated the inconsistency of the demands from the subject advisors as an impediment to constructively focus on the curriculum coverage. Support from subject advisors as specialists and mediation of both policies and resources provided are expected. They must support teachers for them to be able to use the provided resources constructively</p>

Category	Author and year	Existing knowledge	Interpretive discussion
3.2 Inability to access and interpret policy documents- CAPS			Teachers, who taught in the Foundation Phase, had adequate qualifications. Their experiences ranged from 1 to 25 years with vast specialisations yet these were not Foundation Phase oriented.
3.3 usage of resources during teaching and learning of number sense			When the CAPS were implemented, all teachers were given the Policy documents. These documents were rarely seen in teachers' classes as the subject advisors had to ask for the availability thereof.

The interviews and observations conducted gave information about the strategies and methodologies applied in teaching number sense in the Foundation Phase. What the teachers indicated orally was found not implemented as said.

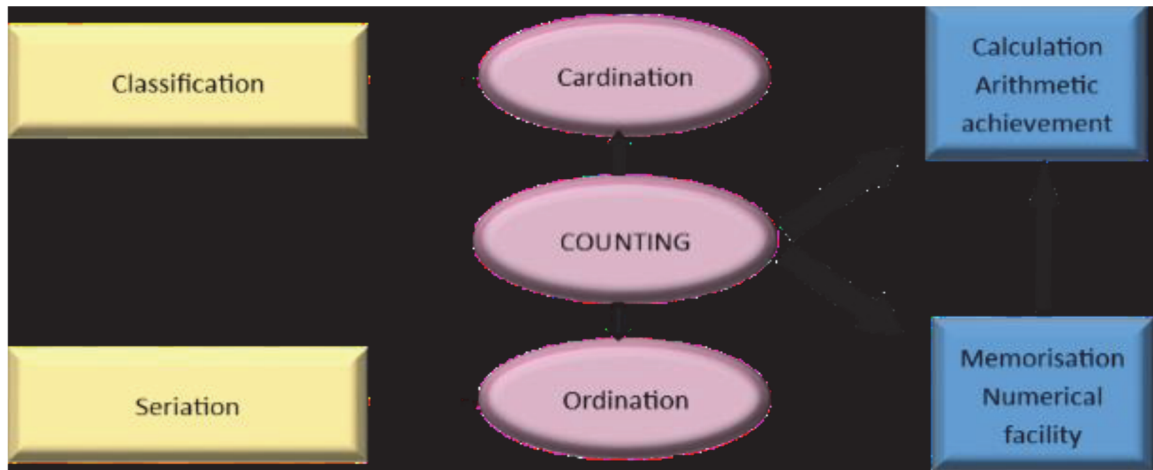


Figure 5.1: Strategies relating to the counting and development of higher thinking skills (Swan, 2019)

5.3 INTERPRETATION OF RESEARCH FINDINGS

5.3.1 Knowledge of number sense through basic perceptual skills

Knowledge of number sense is discussed next.

5.3.1.1 Knowledge of number sense and understanding of concept “number sense”

From the above figure, there is depiction of the perceptual skills in classification and striation. These skills can only be understood through touching and manipulating of the objects. Manipulating the objects through the perceptual skills, leads to the next level of understanding where learners will be able to count at different levels. There was minimal evidence of concretes exposed to learners purposefully. In cases where the concretes were seen, there was no plan and incorporation in the lesson preparation and the actual lesson where learners were involved.

The study revealed that teachers were on different levels of understanding concerning the meaning of number sense as a concept. It seemed that the teachers were not familiar with the term number sense. They had to take some time to explain what they understood by number sense. In practice during observations, they were teaching number sense. In observation, teachers taught number sense not clearly understanding that what they were teaching related to it. There are basic skills that

are imperative in teaching number sense. These perceptual skills are to be initiated by usage of concrete objects where learners make their own interconnectedness of what is in their environment.

Teachers will be left behind in the “4th Industrial Revolution” which is explained by former President Kgalema Motlanthe (2019) as a way of using improved tools, like smart tools which can include electronic gadgets (Newzroomafrika, 2019). However, in the Foundation Phase South African teachers are still at a level where concretes can be used. Learners must be familiarised with these aspects before they advance to the electronics and smart devices. The implicated tools are the concrete resources which the learners need to explore the Mathematics learning through tactile and visual perception. In conversation with the teachers on the weighting of number sense, they did not show any immediate understanding. They could not make connections between the notional times to be spent on teaching of number sense which has to be taught on daily basis.

5.3.1.2 Teachers’ perception towards teaching and learning of number sense

The teachers still displayed a lack of understanding of how to teach number sense to benefit the learners fully. The strategies to teach were not clearly exemplified. The explanation of strategies used affects the teaching and the perception of what is applied in the class. There is a great need of “quality of practice” indicated by Anthony and Harris (2001) as an opportunity not to just merely teach, but to encourage learners to apply thinking skills in a cooperative learning method. Teacher quality and their understanding of what they are worth, conveyance of higher thinking skills and accommodating learner knowledge and skills (Wenglinsky, 2000) will influence the effectiveness of both the learners and the teachers in teaching number sense.

5.4 TEACHERS’ EXPERIENCES IN TEACHING NUMBER SENSE

5.4.1 Planning and preparation for teaching and learning

There was little evidence of planning and preparation found in the teachers’ classes towards teaching number sense in the Foundation Phase classes. In T6’s class, there were concretes which learners interacted with. However, she also used the

GPLMS as lesson plan and no decoding was evident in having developed own notes and preparation.

5.4.2 Understanding the usage of CAPS as a guiding policy

The Policy document was not found in any of the six (6) classes. All teachers indicated that they used the GPLMS. This is the gap which will always affect the compliance with policy. Non-availability of the policy means that teachers will not become conversant with it. They will not be able to know how the policy is being packaged to relate the parts of the policy with daily learning and teaching.

5.4.3 Strategies, techniques and methods in teaching number sense

All teaching should be informed by processes that the teacher is applying in teaching and learning. The different strategies will benefit different learners. It is where the teacher should be able to embrace all learners' strategies. Learners should be given an opportunity to say how they arrived at the answers. There is a tendency of teachers always telling learners what to do and how to do it.

Teachers have to be able to embrace the methods and strategies the learners are bringing to the class. The teacher has to remember that what is important in teaching Mathematics, especially problem solving is the process and not the eventual answer.

5.4.4 Differentiated teaching in the Foundation Phase

Differentiated teaching accommodates differentiated learners. Learners come into our classes with different thinking skills, different knowledge. Some come from stimulated environments while others have had no such experience. The ability to identify such differences becomes an advantage and strength to the teacher. Teachers will be able to occupy learners effectively if they follow the prescribed strategies. The most stimulated, will be occupied at a higher level. Those not stimulated will have to start at a lower level and progress slowly with teacher's efforts to teach. The aim in both situations is to stimulate and teach further towards improved attainment in learning.

Learning groups were found to be necessary, however they should not be permanent. There should be fluidity which will allow learners to learn from one

another. Most of the lower performing learners will benefit from such fluid groups. The teacher has to plan differently which was not evident in all the classes observed.

5.5 THEME 3: CHALLENGES EXPERIENCED BY TEACHERS IN TEACHING NUMBER SENSE

Theme 3 is linked with Chapter 2 where teachers' challenges are addressed as impediments to teaching number sense in the Foundation Phase.

5.5.1 Support, guidance and training of teachers from Departmental Heads, School management Teams and District Officials

The teachers expressed their frustrations when they needed support and guidance in doing their work. Consistency is imperative when support is given. Whenever there are changes that need to be affected, it is necessary that the correct, respectful and timeous changes be communicated to the teachers to avoid confusion and disillusionment. Deliverables can be perceived differently and disillusionment occurs. Hence, the DBE representatives have to communicate the changing issues with caution to the teachers.

5.5.2 Inability to access and interpret the policy document (CAPS)

Kriek and Grayson (2009) indicate that teachers' attitudes determine the practices in teaching and learning. In an attempt to attend to the observed challenges, they developed a model on Holistic Professional Development, where content knowledge, teaching approaches, and professional attitudes were integrated.

In this study, the inadequate support, guidance and training difficulty in accessing the policy documents, were influenced by the teacher's attitudes of taking the content they are trained on further in the Professional Learning Communities (PLC, 2015) and content workshops. These are PLCs encouraged by the DBE, (2012) where teachers have the opportunity to learn from each other on how to deal with content knowledge. Teachers have to take the initiative to have good practices towards sharing approaches which will lead to improved process of learning and teaching in Mathematics. The process will contribute to alleviating anxieties in Mathematics.

5.5.3 Usage of resources during teaching and learning of number sense

There are resources to support teaching of number sense, however, the teachers did not use the resources the way they were meant to be integrated. There are DBE workbooks which are meant to reinforce the concepts and topics taught. The teachers used them in their initial teaching, before they introduced the topic with concretes. Learners were subjected to doing classwork with the worksheets in the DBE workbook.

5.6 THE EFFICACY OF THE THEORETICAL FRAMEWORK TO THE RESEARCH FINDINGS

The theoretical framework that this study was premised on is constructivism focusing on the Zone of Proximal Development (ZPD). Constructivism underscores the value of peer support and assistance by the caregiver. Roth (2012) emphasises that in constructivist teaching and learning, is learner-centred and teachers become facilitators.

The findings in the study relate to the research questions. The teachers' experiences in teaching number sense were found to lack clarity in regard to the meaning of number sense. For learners to attain in mathematical knowledge, the "more knowledgeable one" who is the teacher, should be able to provide authentic knowledge to the learners who are still at the level where they are dependent on the teacher.

Furthermore, addressing the secondary questions, it is imperative that teachers undergo thorough training and support for them to be able to communicate knowledge to the learners. Teachers were able to teach number sense even if they were not aware that what they were teaching was number sense. They were dependent on the scripted lesson plans. Scripted lesson plans needed to be reinforced in conjunction with CAPS to instil creativity. The expectation is that when using CAPS, the teachers could use the initial document as a guiding policy. The teachers followed the ATP without reference to the policy. There were topics that were not elaborated on in the ATP which need to be looked up in the CAPS for teachers to be able to teach the concepts successfully. Preparation at a level of lesson planning and preparation is imperative in the teaching of number sense to

ensure that the necessary components of a lesson are clearly outlined and compliance with notional time is adhered to.

5.7 LIMITATIONS

Creswell (2012), explain that there are strengths and weaknesses in qualitative research. A salient limitation identified in this study is that only six participants participated and one was not interviewed. All participants did also not stay for the full duration of the interviews, but they were all observed during learning and teaching.

One school was used which also presented a limitation. The experiences of the participants ranged from one to 25 years. The teachers were also qualified but not specifically in Foundation Phase teaching. The language of learning and teaching of the school is English, however learners were not conversant with English as per Language of learning and teaching.

Discipline was seen as defeating the purpose of teaching and learning in the large classes. It caused disruptions and observations were disturbed. Preparation of the environment was overlooked. The interview took place after contact time, however the learners playing outside had an influence on the audio tape which impeded the audibility of some responses to the questions asked during the interview.

5.8 RECOMMENDATIONS

5.8.1 Teachers' understanding of the concept "number sense" through perceptual skills

Teachers must be lifelong learners. Mathematics was observed to be a subject that caused anxiety to learning and teaching. It affected both teachers and learners. As we are evolving towards the 4th industrial revolution, it should be taken into account that change is inevitable.

5.8.2 Teachers' experiences in teaching number sense in the Foundation Phase

No teaching can take place without clear and focused planning and preparation. Teachers have to focus on learner attainment and learner-centred teaching. Teachers need to take cognisance of the fact that the impact of teaching and

learning in the Foundation Phase will influence learners for the rest of their academic career especially when learning Mathematics.

The CAPS has to inform every step of teaching and learning. It should be considered to be each one's responsibility to comply with policies that are in place. The resources used should be aligned with the CAPS as the basic curriculum to be implemented in the all teaching and learning in South Africa.

Different levels of teaching should be seen in the usage of different methods and strategies during learning and teaching. The strategies, methods and techniques will accommodate all learners with their differences. Multiple intelligences will make all learners part of learning and teaching with well-planned lessons. As much as learners perform at different levels, they should be given an opportunity to use objects and explore their bodies in an integrated learning of Mathematics in the Foundation phase. Teachers' creativity should be seen by using the environment to explore maths (Naudé & Meier, 2018) which is found everywhere.

5.8.3 Continuous professional development for Foundation Phase teachers to capacitate them in teaching number sense

The HEIs need to ensure that teachers are fully capacitated. This can be implemented by a closer relationship with the schools. The student teachers could be given more time to practise teaching. The lecturers visiting schools should fully understand the school environment and visit more frequently to note progress made by students in class.

The Districts have to take charge of empowering the new teachers' prior entering classes as fully fleshed teachers. The orientation should be on what to do to manage a class. These teachers should be in a demonstration session not only talk show session.

Before they are even given classes, teachers must be briefed on a few basic Foundation Phase principles to guide their teaching. The inability to know what to do in the first day of teaching affects the teachers' capabilities that are found to be compromised by lack of thorough orientation in a real-life situation of teaching.

At school level the HOD should plan in such a way to accommodate the new teachers joining the staff through planning and building on what the District Officials has done. School based Professional Learning Communities should be pitched at an appropriate level so that teachers learn from each other. The new teachers should share their plethora of knowledge and the experienced teachers should share their experiences. This process will bring mutual understanding and acceptance of each other in a professional environment.

“Discipline” as an item for observation was not included. However, I am including it under recommendations as I have seen all teachers grappling with it. On the other hand, lack of discipline as observed, emerged when the class is too large and no focused preparation and resources were incorporated in the lesson.

“Ethical issues” should be taken into consideration because in both interviews and observations sessions, there were teachers and personnel that came into the classes and asked for administrative documents. In the other instance the teacher left the class and spoke with the other teacher outside for about seven (7) minutes.

5.9 CONCLUSIONS

The qualitative approach was employed to investigate the teachers’ experiences in teaching number sense. In-depth data were gathered and knowledge and understanding in teaching number sense was revealed through interviews and observations in a natural setting of the teachers. The participants clearly indicated the lack of using the CAPS in the learning and teaching process which needs to be re-visited. They realised the gaps in their teaching and learning processes. The study revealed their level of experiences and knowledge of number sense need to be sharpened. Despite the teachers’ acknowledgement that they need to improve their knowledge of number sense it is evident that there is a need for in-service training which should include all Foundation Phase teachers as per their categories of experience. Older teachers need to be refreshed on the newest developments.

The policy, CAPS has to be the guiding document as it carries the curriculum. Teachers need to realise that all learning is based on the CAPS and they should adhere to it. The resources that are there should always be aligned with CAPS.

Further studies could focus on the incorporation of CAPS in planning and preparing for learning and teaching. Furthermore, there has to be evidence of planning and preparation before attempting to teach. Planning and preparation should include collection of resources relevant for each lesson. Professional Learning Communities should be a forum where teachers learn and exchange sound and good teaching practices.

6. REFERENCE LIST

- ABEND, G. 2008. The meaning of Theory. <https://doi.org/10.1111/j.1467-9558.2008.00324>.
- ABDULHAMID, L. & VENKAT, H. (2017). Primary mathematics teachers' responses to students' offers: An 'elaboration' framework. *The Journal of Mathematical Behaviour*, available online 7 September 2017.
- ADAMS, P. 2007. Exploring social constructivism: Theories and practicalities, *Education* 313, *International Journal of Primary, Elementary and Early Years Education*, 243-257. [Online] Available from: <https://www.tandfonline.com/doi/full/10.1080/03004270600898893?src=recsys>. [Accessed: 2018-05-05].
- ANDREWS, P. & SAYERS, J. 2015. Identifying Opportunities for Grade One Children to Acquire Foundational Number Sense: Developing a Framework for Cross Cultural Classroom Analyses. *Early Childhood Education*, J43:257.
- ANGHILERI, J. 2001. *Principles and practices in arithmetic teaching: Innovative approaches for the primary classroom*. Open University Pres.
- ANTHONY, H. & HARRIS, D.L. 2001. Collegiality and its role in teacher development: Perspectives from veteran and novice teachers. *Teacher Development*, 5(3):127-128.
- ATTARD, C. 2016. Using contexts to make mathematics meaningful. Western Sydney University.
- ARSHAD, M.N., ATAN, N.A., ABDULLAH, A.H., ABU, M.S. & MOKHTAR, M. 2017. Improving the Reasoning Skills of Students to Overcome Learning Difficulties in Additional Mathematics: A Review. *Journal of Science and Mathematics Letters*, 5, pp.28-35.
- ARENDS, F., WINNAAR, L. & MOSIMEGE, M. 2017. Teacher classroom practices and Mathematics performance in South African schools: A reflection on TIMSS 2011. *South African Journal of Education*, 37(3).
- ASKEW, M. 2012. *Transforming primary mathematics*. Routledge.
- ASKEW, M. 1998. *Teaching Primary Mathematics: A guide for newly qualified & student teachers*. Hodder & Stoughton.
- AUNIO, P., MONONEN, R., RAGPOT, L. & TÖRMÄNEN, M. 2016. Early numeracy performance of South African school beginners. *South African Journal of*

- Childhood Education*, 6(1). [Online] Available from: <https://sajce.co.za/index.php/sajce/article/view/496/442>
- AUNIO, P. & NIEMIVIRTA, M. 2010. Predicting children's mathematical performance in grade one by early numeracy. *Learning and Individual Differences*, 20:427-435.
- AVALOS, B. 2011. Teacher professional development in teaching and teacher education over ten years. *Teaching and teacher education*, 27(1), pp.10-20.
- BAKER, S.E. & EDWARDS, R. 2012. How many qualitative interviews is enough.
- BAROODY, A.J. 2003. The development of adaptive expertise and flexibility: The integration of conceptual and procedural knowledge. *The development of arithmetic concepts and skills: Constructive adaptive expertise*, pp.1-33.
- Baxter, P. & Jack, S. 2008. Qualitative case study methodology: Study design and implementation for novice researchers. *The qualitative report*, 13(4), pp.544-559.
- BEAVER, N., JACKMAN, H.L. & WYATT, S. 2009. *Early Education Curriculum, A Child's Connection to the World*. Wadsworth. USA.
- BELL, J. 2010. *Doing Your Research Project: A guideline for the first-time researchers in education, health and social science*. England: Open University Press.
- BERGER, M. 2004. Heaps, complexes and concepts (part 2). *For the Learning of Mathematics*, 24(3):11-17.
- BISSCHOFF, F.N. 2017. *Understanding factors that may contribute to changes in mathematics teachers' beliefs about mathematics teaching-learning* (Doctoral dissertation, North-West University (South Africa), Potchefstroom Campus).
- BLAKE, B. & POPE, T. 2008. Developmental Psychology: Incorporating Piaget's and Vygotsky's Theories in Classrooms. *Journal of Cross-Disciplinary Perspectives in Education*, 1(1):59-67).
- BOWIE, L., VENKAT, H. & ASKEW, M. 2019. Pre-service primary teachers' mathematical knowledge: An exploratory study. SAAMRSTE. Durban. SA.
- BOWMAN, B.T., DONOVAN, M.S. & BURNS, M.S. 2001. *Zero to Three. Help Your Child Develop Early Math Skills*.
- BREY, A. 2016. The effect of '6 bricks' guided play on grade two learners' visual perception and reasoning abilities. Nelson Mandela Metropolitan University. Cape Town.

- BRIAN, K. 2012. Maths anxiety: The numbers are mounting. *The Guardian*, 30 April. <https://www.theguardian.com/education/2012/apr/30/maths-anxiety-school-support>.
- BRIAND-NEWMAN, H., EVANS, D. & WONG, M. 2012. Teacher subject matter knowledge of number sense. [Online] Available from: <https://files.eric.ed.gov/fulltext/ED573190>.
- BROWN, T.E. 2005. The Influence of Teachers' Efficacy and Beliefs Regarding Mathematics Instruction in the Early Childhood Classroom, *Journal of Early Childhood Teacher Education*, 26:3, 239-257, DOI: 10.1080/10901020500369811.
- BURR, D.C., ANOBILE, G. & ARRIGHI, R. 2017. Psychophysical evidence for the number sense. *Phil. Trans. R. Soc.B* 373:20170045. <http://dx.doi.org/10.1098/rstb.2017.0045>.
- BURTON, D. & BARTLETT, S. 2009. *Key issues for education researchers*. Sage.
- BURNS, M. 2007. *About Teaching Mathematics: A K-8 Resource*. 3rd ed. Sausalito, CA: Math Solutions.
- CASTRONOVO, J. & GÖBEL, S.M. 2012. Impact of high mathematics education on the number sense. *PloS one*, 7(4), p. e33832.
- CHISE, E.N. & TEBEKANA, J. 2017. Factors within the School That Affect the Teaching of English Reading in the Foundation Phase (FP) Grade 3. Walter Sisulu University, Mthatha, South Africa.
- CHINYOKA, K., DENHERE, C. & MAMBEU, J. 2013. Vygotsky's zone of proximal development theory: What are its implications for mathematic teaching? *Greener Journal of Social Sciences*, 3(7):371-377.
- CLARK, K.R. & VEALE, B.L. 2018. Strategies to enhance data collection and analysis in Qualitative research: *Radiologic technology*, 89(5).
- CLARKE, B., GREVHOLM, B. & MILLMAN, R. 2009. *Tasks in primary mathematics teacher education*. New York: Springer.
- CLEMENTS, D.H. & SARAMA, J. 2007. Early childhood mathematics learning. *Second handbook of research on mathematics teaching and learning*, 1, pp.461-555.
- COHEN, L., MANNION, L. & MORRISON, K. 2007. *Research Methods in Education* (6th Edition.). London: Routledge.
- COLLINS English Dictionary: <https://www.collinsdictionary.com/dictionary/english>.

- CRESWELL, J.W. 2008. *Educational Research: Conducting, and evaluating quantitative and qualitative research*. 3rd ed. Upper Saddle River, New Jersey: Pearson Prentice Hall.
- CRESWELL, J.W. 2012. Qualitative Inquiry and Research Design: Choosing Among Five Approaches. California: Sage. Available at: <http://nategabriel.com/egblog/wp-content/uploads/2018/01/creswell2.pdf>. Accessed 16 November 2018.
- CROW, G. & WILES, R. 2008. Managing anonymity and confidentiality in social research: The case of visual data in community research.
- DE CLERCQ, F. 2014. Improving teachers' practice in poorly performing primary schools: The trial of the GPLMS intervention in Gauteng. *Education as Change*, 18(2), pp.303-318.
- DEHAENE, S. 2001. Précis of the number sense. *Mind & language*, 16(1), pp.16-36.
- DENSON, C., AUSTIN, C., HAILEY, C. & HOUSEHOLDER, D. 2015. Benefits of Informal Learning Environments: A Focused Examination of STEM-based Program Environments. *Journal of STEM Education*, 16(1). Laboratory for Innovative Technology in Engineering Education (LITEE). Retrieved October 14, 2019 from <https://www.learntechlib.org/p/151634/>.
- DEPARTMENT OF BASIC EDUCATION. 2011. Curriculum and Assessment Policy Statement (CAPS). Pretoria: Government Printers.
- DEPARTMENT OF EDUCATION. 2009a. Numeracy Handbook for Foundation Phase Teachers: Grades R–3. Pretoria: Government Printers.
- DEPARTMENT OF EDUCATION. 2009b. National Curriculum Statement (NCS). Pretoria: Government Printers.
- DEPARTMENT OF BASIC EDUCATION. 2011. National protocol for assessment Grades R–12. Pretoria: Government Printers.
- DEPARTMENT OF BASIC EDUCATION. 2011. Curriculum and Assessment Policy Statement (CAPS): Foundation Phase Mathematics, Grades R–3. Pretoria: Government Printers.
- DEPARTMENT OF BASIC EDUCATION. 2012. Rainbow Workbooks: Mathematics. Pretoria. Government Printers.
- DEVLIN, K. 2017. *Number Sense: The most important mathematical concept in 21st Century K-12 education*. University in Palo Alto, California.

- DUIGNAN, M. & WALSH, T. 2004. *Insights on Quality: A National Review of Policy, Practice and Research Relating to Quality in Early Childhood Care and Education in Ireland 1990-2004*. Centre for Early Childhood Development and Education.
- DOOLITTLE, P.E. 1997. Vygotsky's zone of proximal development as a theoretical foundation for cooperative learning. *Excellence in College Teaching*, 8(1):83-103.
- EDUCATION ALLIANCE. 2006. *Closing the Achievement Gap: Best Practices in Teaching Mathematics*. Charleston, WV: The Education Alliance.
- EDUCATION AND LABOUR RELATIONS COUNCIL ELRC, 2008. Pretoria: Government Printers.
- EMPLOYMENT OF EDUCATORS ACT. 1998. Pretoria: Government Printers.
- ENGELBRECHT, P., NEL, M., NEL, N. & TLALE, D. 2015. Enacting understanding of inclusion in complex contexts: classroom practices of South African teachers. *South African Journal of Education*, 35(3).
- ENGLISH, L.D. 2002. Mathematics curriculum development for computerized environments: A designer-researcher-teacher-learner activity. In *Handbook of international research in mathematics education* (pp. 669-706). Routledge.
- FISKE, E.B. & LADD, H.F. 2014. *Elusive Equity: Education Reform in Post-Apartheid South Africa*.
- GERSTEN, R. & CHARD, D. 1999. Number sense: Rethinking arithmetic instruction for students with mathematical disabilities. *The Journal of Special Education*, 33(1):18–28.
- GRAVEN, M. & VENKAT, H. 2017. *Improving Primary Mathematics Education, Teaching and Learning: Research for Development in Resource-Constrained Contexts*. Palgrave, MacMillan.
- GRIFFIN, S. 2004. Building number sense with Number Worlds: A mathematics program for young children. *Early Childhood Research Quarterly*, 19(1):173–180.
- HARTNETT, J.E. 2007. Categorisation of mental computation strategies to support teaching and to encourage classroom dialogue.
- HAYLOCK, D. 2010. *Mathematics explained for primary teachers*. 4th edition. London: Sage.

- HYNES-BERRY, M. 2011. *Early Mathematics: What's a Big Idea?* Erikson Institute, Chicago. NAEYC Annual Conference.
- HENSLEY-PIPKIN, C. 2015. *Use of the Physical Classroom Environment as a Teaching and Learning Tool Including the Impact of the CCSSl in Kindergarten through Third Grade Classrooms in Northeast Tennessee*. Electronic Theses and Dissertations. <https://dc.etsu.edu/etd/2556>.
- HILL, H.C., ROWAN, B. & BALL, D.L. 2005. Effects of teachers' mathematical knowledge for teaching on student achievement. *American educational research journal*, 42(2), pp.371-406.
- HEIRDSFIELD, A., 2011. Teaching mental computation strategies in early mathematics. *Young Children*, 66(2), pp.96-102.
- HODGEN, J. & MARKS, R. 2013. The Employment Equation: Why our young people need more maths for today's jobs.
- HORNIGOLD, J. 2017. *Understanding Learning Difficulties in Maths-Dyscalculia, Dyslexia or Dys*. Open University Press.
- HUMBLE, S. 2017. *The Experimenter's A-Z of Mathematics: Math Activities with Computer Support*. Routledge.
- JACKMAN, H.L. 2012. *Early education curriculum, a child's connection to the world*. Wadsworth.
- JAWORSKI, B. 1998. Mathematics teacher research: Process, practice and the development of teaching. *Journal of Mathematics Teacher Education*, 1(1), pp.3-31.
- JONNY, J. & MAHOMED, M. 2011. Difficulties in number sense among students. Employment of Educators Act (1998).
- JOHN-STEINER, V., MEEHAN, T.M. & MAHN, H. 1998. *Laboratory of Comparative Human Cognition*. University of New Mexico.
- JUNG, I. 2005. ICT-pedagogy integration in teacher training: Application cases worldwide. *Journal of Educational Technology & Society*, 8(2), pp.94-101.
- KAMINSKI, E. 2002. Promoting mathematical understanding: Number sense in action. *Mathematics Education Research Journal*, 14(2):133-149.
- KEIPER, S., SANDENE, B.A., PERSKY, H.R. & KUANG, M. 2009. The Nation's Report Card: Arts 2008--Music & Visual Arts. National Assessment of Educational Progress at Grade 8. NCES 2009-488. *National Center for Education Statistics*.

- KILPATRICK, J., SWAFFORD, J. & FINDELL, B. 2001. The strands of mathematical proficiency. Adding it up: Helping children learn mathematics (pp. 115–155).
- KIRSTEN, A.M. 2017. *Early Childhood Development provision in rural and urban contexts in the North-West province* (Doctoral dissertation, North-West University (South Africa), Potchefstroom Campus).
- KOFA, L. 2017. *Elementary Teachers' Perceptions of Mathematics Instruction in Montessori and Traditional Classrooms*. Walden University. USA.
- KRIEK, J. & GRAYSON, D. 2009. A Holistic Professional Development model for South African physical science teachers. *South African Journal of Education*, <http://www.scielo.org.za/scielo>.
- LATTERELL, C.M. & WILSON, J.L. 2013. What is mathematics and why does it matter? *ETC: A Review of General Semantics*, pp.387-394.
- LEDERMAN, N.G. & LEDERMAN, J.S. 2015. What Is a Theoretical Framework? A practical answer. The Association for Science Teacher Education, USA. Doi 10.1007/s10972-015-9443-2.
- LIN, Y. & TSAO, L. 2012. *Elementary School Teachers' Understanding towards the Related Knowledge of Number Sense*. US-China Education Review.
- LODICO, M.G., SPAULDING, D.T. & VOEGTLE, K.H. 2010. Methods in educational research: From theory to practice (Vol. 28). John Wiley & Sons.
- LLOYD, P. & FERNYHOUGH, C. 1999. Lev Vygotsky: Critical Assessments. Routledge.
- LOUIE, N.L. 2018. Culture and ideology in mathematics teacher noticing. *Educational Studies in Mathematics*, 97(1), pp.55-69.
- MARVASTI, A.B. 2004. Qualitative research in sociology. Bonhill Street, London: SAGE Publications Ltd.
- MCGRATH, S., 2010. Beyond aid effectiveness: The development of the South African further education and training college sector, 1994–2009. *International Journal of Educational Development*, 30(5), pp.525-534.
- McLELLAN, E. 2012. Number Sense: *The Underpinning Understanding for Early Quantitative Literacy, Numeracy*, 5(2)3. DOI: <http://dx.doi.org/10.5038/1936-4660.5.2.3>
- MAREE, K. 2007. *First steps in research*. Pretoria: Van Schaik.
- MAREE, K. 2014. *First steps in research*. Pretoria: Van Schaik.

- MAREE, K. 2016. *First steps in research*. Pretoria: Van Schaik.
- MARTIN, M.O. & MULLIS, I.V. 2013. *TIMSS and PIRLS 2011: Relationships among Reading, Mathematics, and Science Achievement at the Fourth Grade-- Implications for Early Learning*. International Association for the Evaluation of Educational Achievement. Herengracht 487, Amsterdam, 1017 BT, the Netherlands.
- MCGEE, J.R., WANG, C. & POLLY, D. 2013. Guiding teachers in the use of a standards-based mathematics curriculum: Teacher perceptions and subsequent instructional practices after an intensive professional development program. *School Science and Mathematics*, 113(1), pp.16-28.
- McLEOD, S.A. 2019. *What Is the Zone of Proximal Development?* Retrieved from <https://www.simplypsychology.org/Zone-of-Proximal-Development.html>.
- WILSON, A.J., DEHAENE, S., DUBOIS, O. & FAYOL, M. 2009. Effects of an adaptive game intervention on accessing number sense in low-socioeconomic-status kindergarten children. *Mind, Brain, and Education*, 3(4), pp.224-234.
- MELISSA, A. 2013. *How to Create a Positive Learning Environment for Children?* <https://www.livestrong.com/article/207728-how-to-create-a-positive-learning-environment-for-children>.
- MERRILL, C. (Ed). 1997. [Online] Available from: <https://doi.org/10.21061/jte.v9i1.a4>.
- MNISI, T.M. 2014. *Design of assessment tasks in grade seven mathematics* (Doctoral dissertation, University of Pretoria).
- MNTUNJANI, L.M., ADENDORFF, S.A. & SIYEPU, S.W. 2018. Foundation phase teachers' use of manipulatives to teach number concepts: A critical analysis. *South African Journal of Childhood Education*, 8(1), pp.1-9.
- MONTAGUE-SMITH, A. & PRICE, A.J. 2012. *Mathematics in Early Years Education*. New York: Routledge.
- MOTLANTHE, K. 2019. (NEWZROOMAFRIKA). ENCA Broadcaster.
- MOYER, P.S. 2001. Are we having fun yet? How teachers use manipulatives to teach mathematics. *Educational Studies in mathematics*, 47(2):175-197.
- MUTHUSAMY, S.K. & WHITE, M.A. 2005. Learning and knowledge transfer in strategic alliances: A social exchange view. *Organization studies*, 26(3), pp.415-441.

- NAUDÉ, M. & MEIER, C. 2014. *Teaching foundation phase mathematics: A guide for South African students and teachers*. Pretoria: Van Schaik Publishers.
- NAUDÉ, M. & MEIER, C. 2018. *Teaching Foundation Phase Mathematics - A Guide for South African Students and Teachers*. Van Schaik Publishers.
- NAUDÉ, M. & MEIER, C. 2019. Elements of the physical learning environment that impact on the teaching and learning in South African Grade 1 classrooms. *South African Journal of Education*, 39(1).
- NIEUWENHUIS, J. 2007. *Introducing qualitative research: First steps in research*. Hatfield: Van Schaik Publishers.
- OKEKE, C. & VAN WYK, M. 2016. *Educational Research: An African Perspective*. Oxford University Press Southern Africa.
- OBIKWELU, C. & READ, J.C. 2012. The serious game constructivist framework for children's learning. *Procedia Computer Science*, 15, pp.32-37.
- PATEL, S. 2015. The research paradigm – methodology, epistemology and ontology – explained in simple language. <http://salmapatel.co.uk/academia/the-research-paradigm-methodology-epistemology-and-ontology-explained-in-simple-language>.
- PIAGET, J. 1964. Part I: Cognitive development in children: Piaget development and learning. *Journal of research in science teaching*, 2(3), pp.176-186.
- PITTALIS, M., PITTA-PANTAZI, D. & CHRISTOU, C. 2015. The development of student's early number sense. CERME 9 - Ninth Congress of the European Society for Research in Mathematics Education, Charles University in Prague, Faculty of Education; ERME, Feb Prague, Czech Republic.
- POPOVIC, G. & LEDERMAN, J.S. 2015. *Implications of Informal Education Experiences for Mathematics Teachers' Ability to Make Connections Beyond Formal Classroom*. <https://doi.org/10.1111/ssm.12114>.
- RAMOLLO, J. K. 2014. The construction of Foundation Phase pedagogy through initial Teacher Education Programmes. University of Pretoria.
- RAMNARAIN, U.D., THOMSON, M.P.C., MUKWEVHO, M.N., GRUSSENDORFF, S. & MCHUNU, S. 2015. Umalusi Curriculum Research.
- RIYANTI, N.T. 2018. Development of TIMSS model test to measure the number sense ability of junior high school students. *Journal of Education, Teaching and Learning*, 3(2):361-366. Pontianak, Indonesia.


- ROBERTS, N. 2016. *Small group teaching: Methods & Techniques*.
<https://www.cardiff.ac.uk/learning-hub/view/small-group-teaching-methods-and-techniques>.
- RODRIGUES, F.G., RODRIGUES JR, W.A. & DA ROCHA, R. 2012, October. The Maxwell and Navier-Stokes equations that follow from Einstein equation in a space-time containing a Killing vector field. In *AIP Conference Proceedings* (Vol. 1483, No. 1, pp. 277-295). AIP.
- ROTH, W.M. 2012. Cultural-historical activity theory: Vygotsky's forgotten and suppressed legacy and its implication for mathematics education. *Mathematics Education Research Journal*, 24(1):87-104.
- SAYERS J., ANDREWS P. & BJÖRKLUND BOISTRUP, L. 2016. The Role of Conceptual Subitising in the Development of Foundational Number Sense. In: Meaney T., Helenius O., Johansson, M., Lange, T. & Wernberg, A. (eds). *Mathematics Education in the Early Years*. Springer, Cham.
- SCHIFTER, D. 2014. Learning to see the invisible: What skills and knowledge are needed to engage with students' mathematical ideas? In *Beyond classical pedagogy* (pp. 123-148). Routledge.
- SHUMWAY, J.F. 2011. *Number sense routine: Building numerical literacy every day in grades K-3*. Stenhouse Publishers. Portland, Maine.
- SIBUYI, C.D. 2013. *Effective teachers' pedagogical content knowledge in teaching quadratic functions in mathematics* (Doctoral dissertation, University of Pretoria).
- SILVER, E.A. 1998. *Improving Mathematics in Middle School: Lessons from TIMSS and Research*. Washington, DC: Office of Educational Research and Improvement (ED).
- SINGH, M. 2019. Top 8 daily routine activities for building strong Number Sense.
<https://numberdyslexia.com/top-8-daily-routine-activities-for-building-strong-number-sense>.
- SPAULL, N. 2015. Schooling in South Africa: How low-quality education becomes a poverty trap. *Research on Socio-Economic Policy*. Stellenbosch University.
- SPRUCE, R. & BOL, L. 2015. Teacher beliefs, knowledge, and practice of self-regulated learning. *Metacognition and Learning*, 10(2):245-277.
- STEVE, C. 2009. Mathematics Anxiety in Secondary Students in England.

- STEYN, M.G., HARRIS, T. & HARTELL, C.G. 2011. Where are the foundation phase teachers for our children? Black students' perceptions. *South African Journal of Higher Education*, 25(3), pp.583-597.
- STOTT, D.A. 2014. Learners' Numeracy Progression and the Role of Mediation in the Context of Two after School Mathematics Clubs (Doctoral dissertation, Rhodes University).
- SWAN, P. 2019. Are you game? [Online]. Prime Number, Vol. 34, No. 3, Jul 2019: 18-19. Availability: <https://search.informit.com.au/documentSummary;dn=531045385675286;res=IELHSS>> ISSN: 0816-9349. [Cited 09 Oct 19].
- SYAFIZA, S. 2017. <https://sites.google.com/site/qim501eiddmockingjay/discussion>.
- TABER, M.R. 2013. Use of a mathematics word problem strategy to improve achievement for students with mild disabilities. Florida Atlantic University.
- TAYLOR, S. 2013. South Africa's participation in TIMSS, PIRLS, SACMEQ and ANA.
- TENNIS, J. 2008. Epistemology, theory, and methodology in knowledge organization: toward a classification, metatheory, and research framework. *Knowledge organization*, 35(2/3), pp.102-112.
- TERRE BLANCHE, M. & SEEDAT, M. 2001. Martian landscapes: The social construction of race and gender at South Africa's National Institute for Personnel Research, 1946–1984. Race, racism, knowledge production and psychology in South Africa, pp.61-82.
- TSAO, Y. L. & LIN, Y.C. 2011. The study of number sense and teaching practice. *Journal of Case Studies in Education*. Minnesota State University Mankato, Taiwan.
- TIMSS. 2011. Assessment Frameworks. Boston College: TIMSS and PIRLS International Study Centre, Lynch School of Education.
- UCT. 2019. <http://www.sdu.uct.ac.za/sdu/projects/r-maths-project>.
- VAN DE WALLE, J.A., KARP, K.S. & BAY-WILLIAMS, J.M. 2015. *Elementary and Middle School Mathematics. Teaching Developmentally*. England. Pearson Education Ltd.
- VENKAT, H. & ADLER, J. 2012. Coherence and connections in teachers' mathematical discourses in instruction. *Pythagoras*33, (3):25-32.
- VENKAT, H. & ASKEW, M. 2012. Mediating early number learning: specialising across teacher talk and tools? *Journal of Education*, 56, pp.67-89.

- VENKAT, H. & ASKEW, M. 2017, February. Focusing on the 'middle ground' of example spaces in primary mathematics teaching development in South Africa.
- VENKAT, H. & ASKEW, M. 2018. Mediating primary mathematics: theory, concepts, and a framework for studying practice. *Educational Studies in Mathematics*, 97(1), pp.71-92.
- VENKAT, H. & SPAULL, N. 2015. What do we know about primary teachers' mathematical content knowledge in South Africa? *International Journal of Educational Development*, 41(2015):121-13.
- VYGOTSKY, L.S. 1987. The Collected Works of L.S. Vygotsky. Vol.1: Problems of General Psychology, including the volume Thinking and Speech, R.W. Rieber and A.S. Carton (eds), N. Minick (trans.), NY: Plenum Press.
- WAY, J. 2011. *Number Sense Series: Developing Early Number Sense*. Enrich. University of Cambridge.
- WALSHAW, M. 2017. Understanding mathematical development through Vygotsky. *Research in Mathematics Education*, 19(3):293-300. [Online] Available from: <https://doi.org/10.1080/14794802.2017.1379728>.
- WENGLINSKY, H. 2000. How Teaching Matters: Bringing the Classroom Back into Discussions of Teacher Quality. Educational Testing Service, Princeton, NJ.
- WIBINERS. 2016. <http://www.gefieo.org/event/s/webinar-systematic-triangulation-applied-identification-evaluation-findings>.
- WILSON, E. ed. 2017. School-based research: A guide for education students. Sage.
- WIUM, A.M. & LOUW, B. 2011. *Teacher support – an exploration of how foundation-phase teachers facilitate language skills*. Department Communication Pathology, University of Pretoria.
- WYNER, J.S. 2019. What excellent community colleges do: Preparing all students for success. Harvard Education Press.
- WRIGHT, R.J., STANGER, G., STAFFORD, A.K. & MARTLAND, J. 2014. *Teaching number in the classroom with 4-8 year olds*. Sage.
- YANG, X., HONG, K.K. & MCBRIDE, C. 2019. *Longitudinal contributions of executive functioning and visual-spatial skills to mathematics learning in young Chinese children*. Hong Kong, China.

7. APPENDICES

7.1 Appendix A: Clearance certificate

 <p>UNIVERSITEIT VAN PRETORIA UNIVERSITY OF PRETORIA YUNIBESITHI YA PRETORIA Faculty of Education</p> <p>RESEARCH ETHICS COMMITTEE</p>	
CLEARANCE CERTIFICATE	CLEARANCE NUMBER: EC 18/10/02
DEGREE AND PROJECT	MEd Teacher experiences in teaching number sense in the Foundation Phase
INVESTIGATOR	Ms Scholastica Mamogale
DEPARTMENT	Early Childhood Education
APPROVAL TO COMMENCE STUDY	05 December 2018
DATE OF CLEARANCE CERTIFICATE	30 August 2019
CHAIRPERSON OF ETHICS COMMITTEE: Prof Liesel Ebersöhn	
	
CC	Ms Bronwynne Swarts Dr Roy Venketsamy
<p>This Ethics Clearance Certificate should be read in conjunction with the Integrated Declaration Form (D08) which specifies details regarding:</p> <ul style="list-style-type: none">• Compliance with approved research protocol,• No significant changes,• Informed consent/assent,• Adverse experience or undue risk,• Registered title, and• Data storage requirements.	

7.2 Appendix B: Ethics statement

Scholastica Maletsose Mamogale,

I have obtained, for the research described in this work, the applicable research ethics approval. I declare that I have observed the ethical standards required in terms of the University of Pretoria's "*Code of ethics for researchers and the Policy guidelines for responsible research*".

Signature: _____

Date: _____

7.3 Appendix C: Letter of consent University of Pretoria



6 May 2019

Student no: **95179578**

Ms SM Mamogale
u95179578@tuks.co.za

Dear Ms Mamogale

APPROVED TITLE AND SUPERVISOR

I have pleasure in informing you that your approved title and supervisor for the MEd is:

Title: Teacher experiences in teaching number sense in the Foundation Phase

Supervisor: **Dr R Venketsamy**
Contact details: **(012) 420 6734, roy.venketsamy@up.ac.za**

You are advised to acquaint yourself with Regulations in the publication 'General Regulations and information'.

Your registration as a student must be renewed annually before 28 February until you have complied with all the requirements for the degree. You will only be entitled to the guidance of your supervisor if annual proof of registration is submitted

Yours sincerely
Pulane Tau

Ms Pulane Tau
for Dean

Administration Building,
1-3
Groenkloof Campus
University of Pretoria
PRETORIA 0002
Republic of South Africa

Telephone number: (012)
420 2725
Fax number: (012) 420
5933

E-mail address:
pulane.tau@up.ac.za
<http://www.up.ac.za/faculty-of-education/>

7.4 APPENDIX D: Agreement to participate in educational research



Faculty of Education

Fakulteit Opvoedkunde
Lefapha la Thuto

Teacher experiences in teaching number sense in the Foundation Phase

Dear Teacher

I am Scholastica Maletsose Mamogale, a Masters student at the University of Pretoria. The title of my study towards my Master's degree is "**Teacher experiences in teaching number sense in the Foundation Phase.**" The aim of the study is to investigate teachers' experiences and to make recommendations to improve the teaching of number sense in the early grades.

I am working under the supervision of Dr. Roy Venketsamy, from the Department of Early Childhood Education at the University of Pretoria.

As one of the participants, I kindly invite you to participate in this study. There are two parts to this research, an interview (using a semi-structured interview questionnaire) and a lesson observation. The interview will be scheduled as per your availability and will take place at a venue convenient to you. The interview should take approximately 90 minutes.

The lesson observation will be 60 minutes. The aim of the observation is to observe the teacher teaching number sense to his/her class. Learners will not be active participants in the lesson observation. It will be the teacher who will be observed.

Your participation in this study is voluntary and confidential. You have the right to withdraw at any point during the research study without any consequences or explanations. You can be assured that your decision will be respected. Confidentiality and anonymity will be guaranteed always by using pseudo names to the participants during the transcription phase. **No participant names or personal information will be reported in my findings.**

In participating in this research study, you will be asked for permission by the researcher to make audio recordings of the semi-structured interview. The purpose thereof is to make transcription of data valid and authentic. The recording will be safely kept at the University of Pretoria. Only my supervisor and I that will have access to the audio recordings. All data collected will only be used for academic purposes.

You may ask questions before or during the time of participation. If you have any concerns regarding the data collection procedures, please notify me or my

supervisor. As a participant, you will have the opportunity to access and verify the recorded views and the transcriptions of interviews made in case there is a need to do so.

Please indicate by signing your understanding of information shared above, the purpose being to give your consent to participate.

Kind regards

SM Mamogale

E-mail address: u95179578@tuks.co.za

Contact number: 082 551 5824

Supervisor: Dr. R. Venketsamy

E-mail address: roy.venketsamy@up.ac.za

7.5 APPENDIX E: Permission for research



Faculty of Education

Fakulteit Opvoedkunde
Lefapha la Thuto

PERMISSION FOR RESEARCH

I, _____, hereby give permission to SM Mamogale to include me as a participant in her research on ***Teacher experiences in teaching number sense in the Foundation Phase***

Signature: _____

Date: _____

7.6 APPENDIX F: Parents informed consent form



Faculty of Education

Fakulteit Opvoedkunde
Lefapha la Thuto

Dear Parent

My name is Scholastica Maletsose Mamogale and I am a Master's student at the University of Pretoria. I am requesting your consent to observe and interview teachers teaching in the grade your child is.

I am assuring you that your child will not be exposed in anyway as I will be conducting the research. No names of learners will be mentioned nor the photographs.

The main focus is on the teacher and not the learners. The research I wish to conduct for my Master's thesis is entitled *Teachers' experiences in teaching number sense in early grades*.

The study will be conducted under the supervision of Dr Roy Venketsamy, Department of Early Childhood Education, and University of Pretoria.

Copies of letters to the teachers to be involved in the research process, are included as well as a copy of the approval letter which I received from the University of Pretoria Research Ethics Committee and the Gauteng Department of Education.

It is important that you are informed that, in any instance that you would wish to withdraw your child from the class in which I will be conducting research from, you have a right to do so.

In conclusion, the information that will be gathered, is hoped to improve the outcry on low learner performance in our country.

Yours sincerely

Scholastica Maletsose Mamogale
University of Pretoria

7.7 APPENDIX G: Request for permission to conduct research from the Principal



Dear Principal

My name is Scholastica Maletsose Mamogale and I am a Master's student at the University of Pretoria. The research I wish to conduct for my Master's thesis is entitled *Teacher experiences in teaching number sense in the Foundation Phase*. The study will be conducted under the supervision of Dr Roy Venketsamy, Department of Early Childhood Education, and University of Pretoria.

I am hereby seeking your consent to approach the foundation phase teachers in grades 1, 2 and 3.

Copies of letters to the teachers to be involved in the research process, are included as well as a copy of the approval letter which I received from the University of Pretoria Research Ethics Committee and the Gauteng Department of Education.

I undertake to provide your office with a bound copy of the full research report on completion of the study. Should any further information be required, please do not hesitate to contact me on 082 551 5824.

Yours sincerely,

Scholastica Maletsose Mamogale
University of Pretoria

7.8 ANNEXURE H: Request for permission to conduct research from the Department of Basic Education



Faculty of Education
Fakulteit Opvoedkunde
Lefapha la Thuto

Dear Director

My name is Scholastica Maletsose Mamogale and I am a Master's student at the University of Pretoria. The research I wish to conduct for my Master's thesis is entitled *Teacher experiences in teaching number sense in the Foundation Phase*. The study will be conducted under the supervision of Dr Roy Venketsamy, Department of Early Childhood Education, and University of Pretoria.

I am hereby seeking your consent to approach the Foundation Phase teachers in grades 1, 2 and 3 in a primary school in the Tshwane West District.

I am giving the assurance that all ethical protocols will be adhered to. It will be adhered to by enclosing copies of letters to the teachers to be involved in the research process. A letter of consent to the school principal has been enclosed. The main focus of the research is on the teachers, however, a letter to the parents has as well been written to give consent of their children to be in such classes.

A copy of the approval letter which I received from the University of Pretoria Research Ethics Committee and the Gauteng Department of Education are also enclosed.

The research is envisaged at mediating challenges that might be emanating from the early grades which might be affecting performance in the higher grades. The strategies, methods and techniques will be observed against the experience of the teachers teaching in the early grades.

Yours sincerely

Scholastica Maletsose Mamogale
University of Pretoria

7.9 ANNEXURE I: Interview questions for the Focus Group Interview

1. What is meant by number sense?
2. What is your understanding of number sense?
3. What are some of the challenges to teaching number sense in the Foundation Phase?
4. How do you use the Policy document against the ATPs?
5. What strategies do you use in teaching number sense?
6. What challenges do you experience in teaching number sense?
7. Do you receive support in teaching number sense from the SMT?
8. Do you receive support from the district officials?
9. What kind of resources do you use in teaching number sense?

