EXPLORING THE ROLE OF PLAY IN TEACHING NUMBER SENSE TO GRADE 3 LEARNERS

by

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submitted in accordance with the requirements for

the degree of

MASTER OF EDUCATION

in

PSYCHOLOGY OF EDUCATION

in the

COLLEGE OF EDUCATION

at the

UNIVERSITY OF SOUTH AFRICA

SUPERVISOR: DR RSS MPHAHLELE

2021

DECLARATION

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I, Mmakgabo Angelinah Selepe, declare that this dissertation is my original work. It has not been presented at any university and all the sources used or quoted have been indicated and acknowledged employing complete references. I further declare that I submitted the dissertation to originality checking software and that it falls within the accepted requirements for originality.

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Date: 15 June 2021

ACKNOWLEDGEMENTS

Firstly, I want to thank God for the precious life he has given me and for giving me the wisdom to complete this project on **"Exploring the role of play in teaching number sense to Grade 3 learners".**

I appreciate the effort of the following people who supported me in completing this study:

To my supervisor, Dr R. S.S Mphahlele, I thank you for all your academic guidance. You have been supportive from the first academic journey of my life. Your professional guidance, endurance, and perseverance enthused me to deeply love education and to continue being dedicated to my work. Thank you for understanding and supporting me academically like your own daughter. Your sleepless nights of waiting to have academics meetings with me are well recognised. May God mightily bless you and your family.

To Magda Botha, thank you for your professional transcription of my semi-structured interview data.

I would like to thank Dr Baumgardt for her remarkable editing work in my dissertation. Because of your professional editing I am able to read with understanding and make sense of my dissertation with straightforwardness.

To my lovely mom, Josephinah Selepe, thank you for your love of education. You taught me the importance of education from a young age and I continued with what you taught me. Thank you for understanding not spending school and festival holidays with family because of my studies. I love you, thank you.

To my principal, Mr Letsoalo Maimela Puis (dad) of Mmananya Primary School, I appreciate the love you have shown towards me from the day we met. The support you have given me throughout my academic journey is noticed. Thank you for helping me to contact public primary principals where I was collecting data on my behalf. I managed to complete this study because of you. Through your continued support, I was able to deliver my professional activities and realised my abilities.

I appreciate family members and academic friends. Ms Thabelang Sefoka, Ms Pinky Madigoe, and Mrs Molepo thank you for supporting me throughout my academic

journey and most importantly for listening to my academic problems and encouraging me with your soft words. To my siblings (my two older sisters), thank you for believing in me and encouraging me to complete this study. Your encouraging words inspired me to work even harder.

To the Limpopo Department of Education as well as public primary schools in the Lebopo Circuit and educators who voluntarily participated in this study, thank you for granting me an opportunity to learn from you.

To everyone that I have not mentioned by name: my colleagues, relatives, and friends, I am grateful how you supported my work. I acknowledge you.

ABSTRACT

The use of a play-based teaching strategy was introduced in the Foundation Phase of the South African curriculum in 2015. Despite interventions made by the South African education ministry, learners continue to perform poorly in Mathematics. The role of play in teaching number sense to Grade 3 learners was examined in this study. The literature addressing the use of play in teaching Mathematics to young children was reviewed. Furthermore, semi-structured interviews, document analysis and non-participant observation were used for the qualitative case study research. This study selected six (6) Grade 3 educators who were teaching Mathematics from three (3) public schools, with two participants from each school. They were interviewed to get their views and experiences concerning the use of play in teaching number sense to Grade 3 learners. Lesson plans, learners' classwork and workbooks were requested to corroborate educators' views on the use of play. Most importantly, educators were observed when teaching Grade 3 learners number sense through play.

The findings of this study showed that educators did not have clear guidance on the use of play when teaching number sense. Educators used play as an intervention strategy, not a teaching strategy. Educators also complained about the lack of cost resources to engage in different types of play to enhance logical-mathematical intelligence. Educators indicated that the role of play in teaching number sense to Grade 3 learners is socialisation.

Drawing from the findings of this study, guidelines were recommended for the use of play were developed. These guidelines were informed by Vygotsky's social development theory and Gardner's multiple intelligence (logical-mathematical intelligence). This study recommends that the suggested guidelines would help educators to use play when teaching number sense.

KEY TERMS: Games; Mathematics; number sense; play; social interaction; multiple intelligences, social development

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LIST OF ACRONYMS

4IR-4th Industrial Revolution

ANA-Annual National Assessments

CAPS-Curriculum Assessment and Policy Statements

DBE-Department of Basic Education

ECD-Early Childhood Development

ECE-Early Childhood Education

FFL-Foundations for Learning

GDE-Gauteng Department of Education

GPLMS-Gauteng Primary Literacy and Mathematics Strategy

LDoE-Limpopo Department of Education

LoLT-Language of Learning and Teaching

LTSM-Learning and Teaching Support Materials

MKO-More Knowledgeable Other

NCCA-National Council for Curriculum and Assessment

NECT-The National Education Collaboration Trust

SASSA-South African Social Security Agency

STEM-Science, Technology, Engineering and Mathematics

TIMMS-Trends in International Mathematics and Science Study

UNICEF-United Nations Children's Fund

UNISA-University of South Africa

ZPD-Zone of Proximal Development

CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION AND BACKGROUND OF THE STUDY

There is evidence that most learners in schools are performing very poorly in Mathematics (Mullis, Martin, Foy & Hooper, 2015). Even the Trends in International Mathematics and Science Study (TIMMS) report supports this statement. So far, TIMSS advanced data have been collected internationally three times, in 1995, 2008 and 2015. The most recent TIMSS data collection included learners in Grades 4, 8 and 12. The results from all three studies conducted by TIMSS from 1995 to 2015 revealed that South African learners perform poorly compared to other participating countries (Mullis et al., 2015). A key aspect of Mathematics and Science education commence at Grade 8 level internationally, earlier, South African data showed that a high number of learners did not even attempt to answer many questions in TIMSS (Govender, 2016). Even though TIMMS does not include Foundation Phase (FP) participants, the relevance of its results for this study is evidence from Hill, Bloom, Black and Lipsey (2008:172), which theorised that the lack of a solid foundation in Mathematics in the lower grades negatively affects the performance of learners in Mathematics in the higher grades.

In the same vein, Letaba (2017) highlighted some of the factors contributing to the low performance of South African learners in TIMMS and further posits that there is increasing concern that affects many children from Early Childhood Development (ECD) such as inequality and the unemployment rate. The effect of the aforementioned factors becomes evident at the later stages of human intellectual development. Letaba (2017) further argued that the White Paper on ECD recommends the strategies to address the inequalities in ECD, which should be noted but performance in Mathematics is not specified in those measures.

It is against this background that this study aims to explore the role of play in teaching number sense to Grade 3 learners. Number sense is an emergent construct that is complex to define. However, Jordan, Glutting and Ramineni (2010) established that number sense is a relevant concept in learning Mathematics in early life even before children enter school.

Learners should exit the FP with a secure number sense, according to the Department of Basic Education's Curriculum Assessment and Policy Statement (CAPS) policy (DBE, 2011b), which is the primary concern of this study. It is envisaged that learners should exit Grade 3 with the following outcomes as stipulated in the CAPS document: knowledge of all mathematical concepts; their meaning; a connection between different kinds of numbers; the proportions of different numbers; ability to represent numbers in different approaches; and the outcomes of working with numbers.

Referring back to TIMMS results, it is safe to conclude that learners do not exit the FP with a good number sense. Annual National Assessments (ANA) were introduced by the Department of Basic Education policy as part of assessing learning issues and creating remedial solutions (DBE, 2011a). The strategic initiatives are unsatisfactory because the TIMMS and ANA revealed that there was the poor performance of Grade 3 learners in the assessment conducted in 2010 where they obtained an average achievement of 28% for Mathematics (DBE, 2011a). However, results have consistently shown that these learners are having difficulties in Mathematics. In contrast, the results reported by ANA that in 2011 only 17% of learners achieved at the minimum of 50% and in the Department of education policy for ANA in 2012 disclosed only 37% learners achieved at the minimum 50% for Mathematics (DBE, 2012). Meanwhile, Grade 3 learners in Capricorn District of Limpopo achieved 34,4 % in Mathematics (DBE, 2012). The average performance of 2014 in Grade 3 in Mathematics at a national level is 55.4%. One of the reasons for this low performance is attributed to poor number sense skills.

There is some evidence that also confirmed by Zosh, Hopkins, Jensen, Liu, Neale, Hirsh-Pasek, Solis and Whitebread (2017) that suggests that play-based learning has the potential to enhance and strengthen children’s learning. Linking this evidence with this study, the researcher acknowledges the argument from Department of Basic Education policy of Play-based learning under spotlight in the basic education in Africa’ DBE (2018) that for learners in Grade 12 to achieve in Mathematics and languages, they should have a good foundational knowledge which is developed through play-based learning in ECD and FP. For learners to understand mathematical concepts, educators need to use a play-based approach to teach. In addition, (DBE, 2018) maintained that the play-based approach is important because it prepares learners for the opportunities and challenges of the 21st century. Seeing that play is regarded as

an essential part of ECD that contributes to the cognitive, physical, social, and emotional well-being of young children, this study sought to explore the role of play in teaching number sense to Grade 3 learners.

The persistence of poor Mathematics results in Grade 3 at the school in which I am teaching led me to want to explore other strategies that can be used to support the teaching and learning of number sense. Of particular interest was to explore how to play as the recommended strategy for teaching in the Foundation Phase can be used to teach number sense especially in Grade 3.

1.2 RATIONALE FOR THE STUDY

Recent developments in the Mathematics curriculum as outlined in DBE (2011b) heightened the need to cover the five content areas in the FP, that is (i) Number, operations and relationships; (ii) Patterns, functions and algebra; (iii) Space and shape; (iv) Measurement, and (v) Data handling. This study focus on number sense, derived from the content area “numbers, operations, and relationships”, which is the main content focus in the FP (DBE, 2011b), as it weighs more than 50% in all the grades. It weighs 65% in Grade 1, 60% in Grade 2, and 58% in Grade 3. It is against this background the researcher argues that if educators can teach number sense well in a manner that learners understand, then learners’ chances of success in other content areas in the Mathematics subject will be improved. Jordan et al. (2010) agreed that number sense makes a meaningful contribution to other content areas in Mathematics achievement in both Grade 1 and Grade 3. Jordan et al. (2010) further argued that number sense is an important intermediate skill that should be considered in the development of early Mathematics in assessments and intervention.

The Mathematics results at the school where the researcher is teaching and the researcher’s quest to improve these motivated this study. The researcher believes that Mathematics can be best taught if a sound basis is laid early on in the FP. If learners leave Grade 3 with a strong understanding of number senses, then building on that knowledge and applying it will lead to problem-solving that is much easier to be successful in Grade 12.

1.3 PROBLEM STATEMENT

It is still a concern that learners in many schools worldwide continue to perform poorly in Mathematics despite efforts by many departments and ministries of education to improve their performance in the subject. In South Africa, the DBE has introduced and implemented strategies aimed at improving the performance of learners in Mathematics such as Foundations for Learning (FFL) and Gauteng Primary Literacy and Mathematics Strategy (GPLMS). The FFL strategy was launched in 2008 with the focus on the system to improve learner performance in literacy and numeracy, but the FFL campaign did not include prepared lesson plans (Nilohelenglukhele, 2013). The Gauteng Department of Education (GDE) extended the mandate of improving the Mathematics and Languages performance of learners by establishing what they called GPLMS. The aim of GPLMS was similar to FFL; however; it was short-lived and was not extended to other provinces.

The previous report by the DBE (2018) revealed some psychosocial problems resulting from poor Mathematics performance such as high repetition rates and learner drop-out. The report painted the picture of the repetition rate as follows: learners that were repeating Grade 3 in 2014 comprised about 9.6%, in 2015 they comprised 8.9% and in 2016 they comprised 7.3%. According to Human, Van der Walt and Posthuma (2015), one way to address poor performance in Mathematics is through educators being equipped to devise strategies and develop their pedagogical skills to provide relevant content knowledge to learners.

According to Gillespie's study (2021), there is a significant relationship between number sense and Mathematics, and this concept contributes to a high level of mathematical understanding. However, the role of play in teaching number sense to Grade 3 learners has received much too little attention. This study contributes to the importance of using play by Grade 3 educators in teaching number sense to increase their learner’s knowledge on mathematics.

1.3.1 Research Questions

Drawing from the problem statement above, the researcher framed the following research questions to guide this study:

The central question in this study asks:

- What role does play perform in teaching number sense to Grade 3 learners?

Sub-questions

- How can play be used to teach number sense to Grade 3 learners?
- What types of play can help to teach number sense to Grade 3 learners?
- What guidelines do educators follow when integrating play in the teaching of number sense?

1.3.2 Aim and Objectives

This study aimed to explore the role of play in teaching number sense to Grade 3 learners. Therefore, the following objectives will be addressed to realise the aim of this study:

- To establish how play can be used to teach number sense to Grade 3 learners.
- To identify types of play that can help to teach number sense to Grade 3 learners.
- To recommend guidelines on the use of play when teaching number sense to Grade 3 learners.

1.4 PRELIMINARY LITERATURE REVIEW

The literature review of this study consists of two sections. The first section lays out the theoretical dimensions of this study by discussing the two theories which influenced this study that is; Vygotsky's social development theory, and Gardner's multiple intelligence theory. These sections are explained in detail in Chapter 2, which shows the need for these two theories to be linked with the role of play in teaching number sense to Grade 3 learners. Most importantly, one needs to understand these theories and be able to apply them in the teaching number sense. The researcher discusses the role of educator as More Knowledgeable Other (MKO) when using play in the Mathematics classroom and the relationship between play and social interaction in the teaching of Mathematics and logical-mathematical intelligence. In the second section, the researcher reviews the literature to identify the knowledge gaps. To do this, the researcher uses the following topics that are interconnected to the research questions formulated for the current study:

- The role of play in teaching number sense.

- The use of play in teaching number sense.
- Types of play that can help to teach number sense.

1.4.1 Vygotsky's Social Development Theory

Gani, Abdullahi, Abdulkareen and Allahmagani (2017) confirmed that the primary focus of Vygotsky's Social Development theory is knowledge construction through social interaction. Several studies such as Gani et al. (2017) and Leach (2015) highlighted three basic constructs of social development theory, namely: MKO, Zone of Proximal Development (ZPD) and social interaction. This study adopts the MKO because the focus of this study is on social interaction between the learners with an educator as a facilitator who has more knowledge than learners. The researcher discusses the role of the educator as MKO when using play in the Mathematics classroom and the relationship between play and social interaction in the teaching of Mathematics.

1.4.2 Gardner's Theory of Multiple Intelligence

According to Hanafin (2014), there are at least eight (8) relatively autonomous but interconnected intelligences: linguistic, logical-mathematical, visual-spatial, bodily-kinaesthetic, musical, interpersonal, and intrapersonal and naturalist. Only logical-mathematical intelligence is discussed in this study. Kelly (2019) agreed that learners with high logical-mathematical intelligence like to work with mathematical problems, excel at strategy games, look for rational explanations and like to categorise. It was also confirmed by Nur, Herman, and Mariyana, (2018) that logical-mathematical intelligence is related to the achievement of several mathematical skills such as reasoning, calculations, logic, critical thinking and abstract thinking. The researcher seeks to expand logical-mathematical experiences through real-world activities such as using play. Rosli and Lin (2018) supported this by demonstrating that play can be carried out in the real world. The frame of this study is social interaction because it is the common concept that seems to be evident in the two theories.

1.4.3 Preliminary Literature Review

The researcher aimed to review the literature to identify knowledge gaps concerning the role of play in teaching number sense to Grade 3 learners guided by Winchester and Salji (2016). Furthermore, the researcher reviewed and incorporated what other

researchers have reported about the role of play in teaching number sense to Grade 3 learners.

1.4.3.1 The role of play in teaching number sense

The researcher was informed by the work of scholars such as Kermani (2017) and Nejem and Muhanna (2013) that the main role of play in teaching Mathematics is socialisation. One example is that of computer games. Kermani (2017) stated that computer games are effective when accompanied by teacher facilitation and scaffolding, which creates socialisation in the teaching of number sense. In addition, Nejem and Muhanna (2013) maintained that using computer games in teaching Mathematics help learners to communicate and to interact, but also to develop work social skills.

1.4.3.2 The use of play in teaching number sense

After reviewing the literature on the role of play in the teaching number sense, the researcher reviewed the literature on the use of play in teaching number sense globally. As a result, the literature was sourced from two (2) different regions, namely, Europe and Africa with a focus on South Africa. The countries in these regions have similar Early Childhood Education (ECE) education systems and they use play to teach Mathematics, However, there are limited studies that have focused on using play to teach number sense.

1.4.3.3 Types of play that can help to teach number sense

Since very few studies have discussed the literature on the types of play that can be used to teach number sense, the researcher reviewed the literature on types of play that can be used to teach mathematical concepts since number sense is embedded in mathematical concepts. The researcher focused on some of the types of play from Dicker and Naude (2019), namely, physical, construction, exploratory, creative and word.

1.5 RESEARCH METHODOLOGY

Igwenagu (2016) mentioned that research methodology helps the researcher to plan their research method. Long (2014) showed that there is an existing relationship between research methodology and the selection of research methods that helps the

researcher to collect data. The research methodology outlined how the researcher selected suitable research methods for this study.

1.5.1 Research Design

Asenahabi (2020) explained that a research design is a guide for selecting appropriate research methods for the study. Rashid, Rashid, Warraich, Sabir and Waseem (2019) explained that a qualitative case study is a design that helps in the exploration of a phenomenon within some particular social context.

1.5.1.1 Interpretive research paradigm

The paradigm for this study was interpretivism because it refers to the researcher's beliefs and the way they view their world. Kivunja and Kuyini (2017) indicated that the research paradigm defines the researcher's worldview and establishes the beliefs that shape how the researcher views and interprets the world. Rehman and Alharthi (2016) posited that interpretivist researchers explore their world and find the truth from participants. The research paradigm of this study employed an interpretivist lens because the researcher aimed to explore the role of play from the views and perspectives of educators when teaching number sense to Grade 3 learners.

1.5.1.2 Research approach

It is a widely held view that a research approach is a plan and procedures to research methods of data collection, analysis, and interpretation. Creswell (2014) pointed out that a research approach is a plan and a procedure for research that involves the steps from broad assumptions to specified methods of data collection, analysis, and interpretation. Chetty (2016) also noted that a research approach is a plan and procedure that entails the steps of broad assumptions to a comprehensive method of data collection, analysis, and interpretation. Drawing from this background, the researcher used a research approach as a plan and procedures to guide methods to collect data, analysis and interpretation.

Creswell (2014) outlined three research approaches as qualitative, quantitative and mixed methodology. The researcher chose to use a qualitative approach. The qualitative research approach was chosen because Rehman and Alharthi (2016) indicated that interpretive researchers employ methods that generate qualitative data.

This was supported by Dean (2018) who revealed that an interpretivist paradigm is frequently used in qualitative research. The researcher conducted a qualitative study following an interpretivist paradigm.

1.5.1.3 Interpretive case study design

Astalin (2013) indicated that qualitative research design consists of phenomenology, ethnography, grounded theory, and case study. They are well discussed in Chapter 3. Rashid et al. (2019) showed that case study design is appropriate for a researcher who aims to explore social issues within a particular social context. As such, the researcher used an interpretive case study design to explore the role of play in teaching number sense to Grade 3 learners that create social interaction between researcher and participants. This research design was supported by Harrison, Birks, Franklin and Mills (2017) who pointed out that the interpretive case study approach is usually used when researchers are aiming to explore issues such as human behaviour and social interaction.

1.6 RESEARCH METHODS

There is some evidence from Igwenagu (2016) and Long (2014) to suggest that there should be a relationship between research methodology and research methods. Igwenagu (2016) mentioned that research methods are derived from research methodology, while Long (2014) confirmed that the selection of research methods is guided by research methodology. Since this study adopted an interpretive case study design, the selection of participants and the design of data collection tools and techniques were guided by this choice, and while data analysis was guided by the principles of a qualitative research approach.

1.6.1 Selection of Participants

According to MacMillian and Schumacher (2014), a population can be defined as anything that can fit set standards that the researcher wishes to explore and analyse. Baškarada (2014) and Denzin and Lincoln (2011) mentioned three types of population, namely: general, target, and accessible population. For this study, the population referred to educators that were teaching Mathematics to Grade 3 learners.

For this study, the researcher purposively sampled participants from the target population. The researcher aimed to explore their views on the role of play in the teaching of number sense. Etikan and Bala (2017) and Issaka (2018) highlighted that purposive sampling is used where the researcher seeks to find the valid truth from participants who meet certain criteria that are determined by the researcher. Informed by this, the researcher sampled Grade 3 educators who were teaching Mathematics.

Maximum variation within purposive sampling was used to sample educators from three public primary schools. Two educators from each school were selected according to their age, work experience and qualifications. A total sample of six (6) educators was selected. The researcher was not teaching in any of those three (3) schools to avoid conflict of interest. The schools were near the school where the researcher was teaching. For purposes of confidentiality and anonymity, the schools were named School 1, School 2, and School 3. Each school had two (2) Grade 3 educators. They were all in Capricorn South District in rural areas of the Limpopo Province. The Language of Learning and Teaching (LoLT) in the Foundation Phase was the home language of the majority of the learners, namely, Sepedi. More details on LoLT are provided in Chapter 3.

1.6.2 Data Collection

Yin (1994) explained that researcher who uses an interpretive case study design should select research instruments such as document analysis, archival records, interviews, focus group discussions, observations and physical artefacts to collect data. This study used semi-structured interviews, document analysis, and non-participant observation to collect data. Table 1.1 below summarises how the selected research instruments supported the data collection process.

Table 1.1: Data collection methods

Research instruments	Form of data collected	Specified data source	A tool used to gather data	Captured data
Semi-structured interviews	Educators' views and experiences on the use of play in teaching number sense to Grade 3 learners	Grade 3 educators who are teaching Mathematics	Interview schedule	Audio
Document analysis	Corroborates educators' responses from semi-structured interviews to see how they are preparing lessons to teach number sense to Grade 3 learners. The researcher interpreted and analysed documents from educators	Lesson plans, classwork books, and DBE workbooks	Document analysis tool	Text
Non-participant observation	The researcher observed the educators using play to teach Grade 3 learners number sense. This was used to triangulate the data from the interviews with documents data to verify the relationship between the planned learning activities with what is implemented in the classroom.	Grade 3 educators and learners	Observation tool	Text

Source: adapted from Mphahlele, 2018.

1.6.3 Data Analysis

Hammond (2019) emphasised that qualitative data has to be well managed because of its in-depth nature. Pérez (2019) showed that qualitative data can be analysed by using different methods and techniques such as content analysis, narrative analysis, and grounded theory. This study selected narrative analysis as it requires the researcher to manage data by breaking it into manageable codes and categories for analysis and presenting it as a report (Hammond, 2019).

The researcher prepared data from semi-structured interviews, document analysis, and observation for data analysis. Since all should be in a text format before analysis, the researcher took audio data from semi-structured interviews to a professional transcriber to be transcribed into text. The researcher organised the primary data from the semi-structured interviews, document analysis, and non-participant observation according to schools. The researcher coded the primary data manually and later imported it into qualitative data analysis software called Atlas.ti to code it.

1.7 CREDIBILITY AND TRUSTWORTHINESS

The study acknowledged that qualitative research includes credibility, transferability, dependability, and confirmability to ensure trustworthiness as the core principle in qualitative studies. This study used credibility and dependability.

1.7.1 Credibility

The credibility of the study, as pointed out by Pilot and Beck (2014), is the most important criterion in the qualitative approach. In addition, Connelly (2016) established techniques that one can use to ensure credibility. These techniques include, among others, internal bias and internal validity. The researcher requested scholarly advice to ensure quality of data for internal validity.

1.7.2 Dependability

Cope (2014) asserted that trustworthiness or truth value in interpretivist qualitative research and transparency of the conduct of the study is crucial to the usefulness and integrity of the findings. This study will look at educators' use and understanding of play when teaching number sense. The researcher thus deemed it noteworthy to state that the truth of educators is interpreted and explored by a researcher from observing

how educators use play to teach number sense. The researcher and her study supervisor co-coded data to ensure the dependability of the study.

1.8 RESEARCH ETHICS

Arifin (2018) indicated that ethical considerations in a qualitative study are important because of the in-depth study process. Arifin (2018) further stated that participants in a qualitative study need protection from any potential harm. They also have to be competent to consent, and additionally have the right to anonymity and confidentiality. The researcher adhered to the principles of informed consent, voluntary participation, and confidentiality and anonymity accords. The researcher applied for permission to conduct this study as follows:

1. Application to University of South Africa (UNISA) Ethics Committee for ethical clearance.
2. Application for permission to the Limpopo Department of Education (LDoE) (because the study was conducted in the three (3) public primary schools in Limpopo, Capricorn South District), to conduct the research.
3. After obtaining the ethical clearance certificate and approval from the LDoE, the researcher sent letters to the principals of the identified three (3) public primary schools to gain permission to research their schools.
4. After obtaining permission from principals to research their schools, the researcher sent participants letters of consent to gain their permission to take part in the study. In the consent form, there was also a request for distribution of parental consent that was required for obtaining the information from their children's classwork and workbooks. There was also an assent form for Grade 3 learners.
5. Before the interviews and observations, participants were given information sheets with informed consent forms attached, and they were requested to complete the informed consent forms after reading the information sheet. The information sheet provided the background to the study, aims and objectives, and the limitations of the research.

1.9 DELIMITATIONS

MacMillian and Schumacher (2014) refers to delimitations and limitations as particular parameters and demographics for a research study

This study focused only on public primary schools in deep rural Limpopo in Capricorn South District. The three schools were chosen because they used the same curriculum (CAPS) and they fell under a similar circuit (Lebopo Circuit). They had equivalent teaching and learning resources in the use of play when teaching number sense. Private primary schools were not selected because educators are not obliged to use play when teaching number sense.

Concerning the population of the study, only six (6) educators who were teaching Mathematics in Grade 3 were involved because they were expected to use play when teaching number sense.

1.10 CONCEPTUAL FRAMEWORK

In the past years, researchers found that a conceptual framework is needed to identify the main concepts of the study within the problem of the research. This statement was alluded to by researchers such as Luse, Mennecke and Townsend (2012) who reported that a conceptual framework helps the researcher to easily specify and define the concepts that are important in the study.

Adom, Hussein and Agyem (2018) and Grant and Osanloo (2014) added that conceptual framework helps to identify main concepts that have a relationship with each other within the study. Grant and Osanloo (2014) guided us that concepts in the conceptual framework should be arranged in a logical structure. Thus, the researcher defined concepts in this study alphabetically.

1.10.1 Game

Arjoranta (2019) defined a game as an activity that has rules and creates interaction between players. Stenros (2017) also described a game as a form of art in which players make decisions to integrate into the play. In addition, Uz and Cagiltay (2015) stated that a game is an activity that creates a social situation among competing players. Furthermore, Akcaoglu (2014) added that a game is a problem-solving activity that is approached with a playful attitude. Guided by this background, the concept “game” in this study means an activity that is used by players to solve a problem and that creates social interaction when they are abiding by the rules of play.

1.10.2 Mathematics

According to DBE (2011b), Mathematics can be defined as a language of using numbers to solve problems. Sari and Olkun (2019) showed that achievement in Mathematics can be measured by a good number sense. For this study, the concept "Mathematics" refers to the ability to have good number sense and be able to solve mathematical problems through social interaction.

1.10.3 Number Sense

Studies such as Hogan (2017), Hornigold (2019) and Way (2011) stated that number sense is the ability to work with numbers and can be taught through play. Hogan (2017) explained that number sense is the ability to recognise the relationship between numbers; for example, pupils can learn number sense by looking at numbers in a deck of cards or identifying numbers on dice or dominoes without counting them. Hornigold (2019) stated that number sense is the ability to explore numbers, and children with good number sense enjoy playing with numbers that can be taught through opportunities of exploring and playing with numbers. Way (2011) also defined number sense as the ability to count numbers, stating that activities that can be used to teach number sense with moveable objects such as counters, building blocks and through construction play. The concept "number sense" is predominantly used in this study to refer to an ability to explore and recognise the relationship between numbers.

1.10.4 Play

Numerous scholars such as Anwar, Kristiadi, Novezar, Tanto, Septha, Ardhia, Evan, Chrysler, Warnars and Abraham (2020), Gray (2013; 2017) and Hanghøj, Lieberoth & Misfeldt (2018) held the view that play is an activity that creates socialisation among players. Gray (2013) defined play as an activity that is guided by rules that are socially agreed upon and players should follow those rules. Similarly, Gray (2017) mentioned that play is a social activity where two or more children are involved. Gray (2017) further asserted that when children are playing, they learn how to get along with peers, compromise, negotiate, recognise one's needs, and please others. In addition, Gray (2013) proposed that play is an essential activity to children that creates bonding through social interaction between parents and children. Throughout this study, the

concept “play” refers to an essential activity that creates social interaction between players.

1.10.5 Social Interaction

There is some evidence from Mele (2017) that social interaction is a process whereby people act and react concerning each other that can develop the human mind through meaningful interaction with others. Similarly, Ostrosky and Meadan (2010) affirmed that social interaction is created when children play together and share toys. Furthermore, Bekker, Sturm, and Eggen (2010) maintained that social interaction in young children is stimulated through physical play. Bekker et al. (2010) further affirmed that when children play, they can create their own rules which stimulates one of the skills of social interaction. The definition put forward by Bekker et al. (2010) about social interaction is used in this study.

1.10.6 Teaching

It is a thought that teaching is a process of imparting knowledge to individuals. This statement is supported by Calaby (2020) who highlighted that teaching is a process of imparting knowledge from educators to their learners to help them understand new concepts about a specific concept. In addition, Jackson and Everington (2016) showed that teaching is a process of imparting knowledge to instruct an individual to solve a problem. Mamo and Amidu (2015) agreed that teaching is a lifelong process of imparting knowledge, skills and values to the learners. “Teaching” in this study is defined as a process of imparting new knowledge to learners that helps them to understand new concepts to solve problems.

1.11 CHAPTER DIVISION

Chapter 1 presented an overall background and rationale of this study, statement of the problem also research questions, aim and objectives were formulated. The chapter also discussed preliminary literature with theoretical frameworks that underpinned this study. Furthermore, it provided research methodology and design, credibility, validity, and trustworthiness as well as research ethics.

Chapter 2 reviews the role of play in teaching number sense to Grade 3 learners being guided by the theoretical framework of Vygotsky’s social development theory and

Gardner's theory of multiple intelligences. These topics were discussed: the role of the educator as MKO when using play in the Mathematics classroom, the relationship between play and social interaction in the teaching of Mathematics and logical-mathematical intelligence. This chapter also discusses themes such as the role of play in teaching number sense, the use of play in teaching number sense and types of play that can be used to teach number sense. This was guided by the research questions of this study.

Chapter 3 explains all details of the research methodology. An interpretive case study design within qualitative research approach was selected. Additionally, the research used methodological triangulation where semi-structured interviews, document analysis and non-participant observation were selected to collect data from six qualified Foundation Phase educators who teach Mathematics in Grade 3. Framing of data analysis was also determined by literature review where Atlas.ti was chosen to analyse the data in Chapter 4. This chapter discusses credibility, validity and ethical considerations applied during the collection of data.

Chapter 4 presents the analysis and interpretation of data collected through semi-structured interviews, document analysis and non-participant observation analysed through Atlas.ti. Document analysis was used to corroborate educators' responses from the interviews to see how they plan lessons. Observations were used to verify the educator's views and perceptions. This chapter shows that the researcher explored the views and experiences of educators on the role of play in teaching number sense to Grade 3 learners. In this chapter, the findings of this study are interpreted and discussed with cross-references to the literature review (Chapter 2) that focuses on social interaction on using play to teach number sense.

Chapter 5 provides a summary, conclusions showing how the objectives are met and recommendations.

1.12 CHAPTER SUMMARY

This chapter provided an introduction and background to this study on a general overview of the role of play in teaching number sense to Grade 3 learners. The statement of the problem, research questions, and aims and objectives of this study were also provided. Furthermore, the research methodology, research design,

research paradigm and data collection methods were discussed as well as the population of the study, sampling procedures and data analysis techniques. The chapter also discussed trustworthiness and research ethics and provided the key concepts underpinning this study. The next chapter discusses the literature review.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

A literature review has an important role in research since it integrates and synthesises ideas from other researchers on the topic of concern (Grant & Osanloo, 2014; Pare and Kitsiou, 2017; Snyder, 2019). Winchester and Salji (2016) stated that a literature review is a tool that enables a researcher to identify knowledge gaps and shape the research to provide a clear understanding of the phenomenon to the readers of the thesis. Skills for Learning (2018) further concurred that the additional role of the literature review is to allow a researcher to know what has already been found about that topic in the field of study. It is against this background that the researcher reviewed the literature to identify knowledge gaps concerning the role of play in teaching number sense to Grade 3 learners. Furthermore, the researcher is of the view that integrating what other researchers have found about the role of play in teaching number sense to Grade 3 learners will meaningfully shape this study.

This literature review chapter consists of two sections as a result. The first section presents the theoretical dimensions of this study by discussing the two theories that influenced this research, that is, Vygotsky's social development theory and Gardner's multiple intelligences theory. As highlighted in Chapter 1, this section explains in detail the need for these theories to be linked with the role of play in teaching number sense to Grade 3 learners. Most importantly, one needs to understand these theories and be able to apply them in the teaching of number sense. In the second section, the researcher reviews the literature to identify knowledge gaps in this study. This was done by reviewing the literature on the following topics that are connected to the research questions formulated for this study: the role of play in teaching number sense; the use of play in teaching number sense; and types of play that can be used to teach number sense. Figure 2.1 illustrates the outline of this chapter.

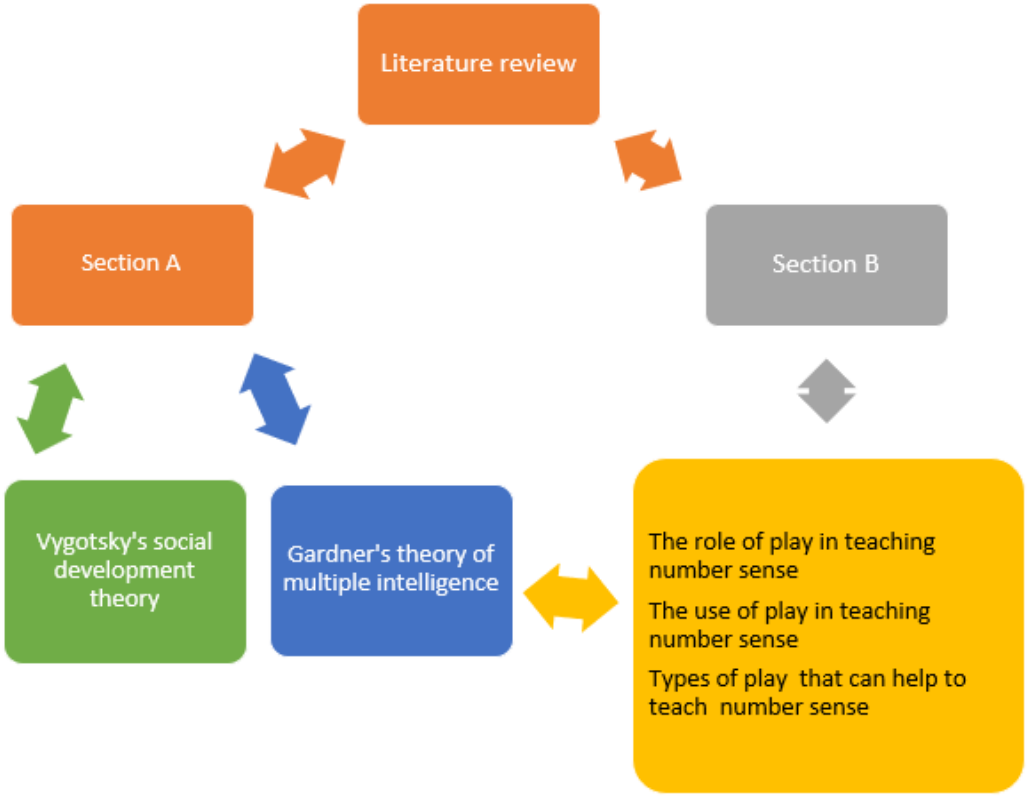


Figure 2.1: Outline of Chapter 2

Starting with Section A (theoretical framework) that adopts Vygotsky's social development theory and Gardner's theory of multiple intelligence, this figure further illustrates that the theoretical framework extends to the topics formulated from the research questions to guide the literature review in Section B of this chapter.

2.2 SECTION A: THEORETICAL FRAMEWORK

Recently, researchers have shown an increased interest in using a theoretical framework to frame their studies. This is evident through the studies conducted by Ravitch and Carl (2016), Brondizo, Leemans and Solecki (2014) and Adom et al. (2018) that confirmed that a "theoretical framework" is used to assist researchers to identify or select theories in the literature that have been tested and validated by other scholars. Although the theoretical framework has been widely used for the selection of theories, Akintoye (2015) hypothesised that it can also help in generalising research findings.

Against this backdrop, the researcher used the theoretical framework for the reasons outlined below.

- Firstly, to select the theories relevant for this study.
- Secondly, for mapping the research by linking the research questions formulated in Chapters 1 and 3 with the selected theories.
- Thirdly, to use it to frame the data analysis process in Chapters 3 and 4, and lastly, in the generalisation of findings in Chapter 5.

The theoretical framework underpinning this study consists of two theories, namely, Vygotsky's theory of social development and Gardner's theory of multiple intelligences. These two theories serve as a lens through which the phenomenon that is the subject of this study is viewed. In the section below, the researcher discusses these theories.

2.2.1 Vygotsky's Social Development Theory

What most scholars know about social development theory largely focuses on social interaction. However, there is a rich history behind this theory that is often neglected. At first, it was known as the theory of cognitive development Nicolopoulou (1993) and later as social development theory (McLeod, 2018). It has conclusively been shown by Vygotsky (1978) that the focus of his theory is also on the role of social interaction in the development of cognition. Recent evidence from a study by Shaffiee and Subri (2014) showed that the focus presented by Vygotsky (1978) has not changed. Shaffiee and Subri (2014) maintained that culture and social factors that are focused on social development theory also contribute to cognitive development. Thus, these theories are linked to the main aim of this study that sought to explore the role of play in teaching number sense to Grade 3 learners.

Furthermore, this section provides the background on Vygotsky's social development theory concerning how social interaction and culture can influence the teaching of number sense to Grade 3 learners. Gani et al. (2017) confirmed that the primary focus of this theory is knowledge construction through social interaction. Several studies such as Gani et al. (2017) and Leach (2015) have identified three basic constructs of social development theory, namely: More Knowledgeable Other (MKO), Zone of Proximal Development (ZPD), and social interaction. It is also believed that social

interaction plays a fundamental role in the process of cognitive development. In contrast, the study by McLeod (2018) indicated only two principles of Vygotsky's work, namely, the MKO and the ZPD.

Despite their differences on social interaction, Gani et al. (2017), Leach (2015), and McLeod (2018) agreed that MKO and ZPD contribute to cognitive development. As such, this study adopts the MKO because the focus of this research is on social interaction between the learners with an educator that has more knowledge as a facilitator. The study adopts the approach by Shaffiee and Subri (2014) where social interaction and culture are put together to stimulate learning. In addition, Graven and Lerman (2014) stated that the "other" can also be the learner. Below the researcher highlights the link of MKO with this study by discussing the role of each selected construct of Vygotsky's social development theory.

2.2.2 The Role of the Educator as MKO when using Play in the Mathematics Classroom

Literature reports that the main role of MKO is to develop (social) interaction. This statement is supported by Roth and Radford (2010) who specified that learners learn Mathematics in certain kinds of (social) interactions. Previous research by Roth and Lee (2003) has shown that the initial knowledge of an individual is grounded in their interaction with people around them. Similarly, Topçiu (2015) maintained that educators should demonstrate ideas and strategies to learners when they are interacting with their peers.

Current research has primarily concentrated on interactions in the field of play in Mathematics education. Wium and Louw (2012) showed that social involvement in Mathematics activities is important, as MKO plays a crucial role when engaging with young children to acquire mathematical concepts during play. Similarly, Clements and Sarama (2009) found that in mathematical play in ECE, the MKO's role is to understand the level of conceptual knowledge of children when interacting with them. This is consistent with the literature of Özdogan (2011), which showed that the role of MKO is to guide activities that help children to construct their mathematical knowledge. Fu (2010) mentioned that the role of MKO is to use multiple teaching strategies and techniques when teaching Mathematics in a play setting to encourage learning through social relationships. Özdogan (2011) further elaborated that the role of MKO is to build

relationships with children when engaging in mathematical play. Although the role of MKO is to interact in mathematical activities, Moomaw (2011) indicated that play creates interaction on its own when children interact with one another when solving mathematical problems. In support of Moomaw (2011), the researcher posits that there is a relationship between play and interaction in the teaching of Mathematics.

2.2.3 The Relationship between Play and Social Interaction in the Teaching of Mathematics

It is widely assumed that the relationship between play and socialisation is directly proportional because an increase in play opportunities also increases the extent of socialisation. The above finding is consistent with the study by Daubet, Ramani and Rubin (2018) who examined the relationship that exists between play and socialisation, by demonstrating that play-based learning takes place from active engagement and interaction in learners in the same environment. White (2012) found that play activities increased the level of socialisation, which is consistent with the literature. In this study, the researcher sought to strengthen the relationship between socialisation and play when teaching number sense. Evidence from United Nations Children's Fund (UNICEF, 2018) supports this endeavour by stating that educators should use different teaching strategies to strengthen learning through play.

Even in the field of Mathematics, there is evidence that socialisation takes place when teaching mathematical concepts. The findings of Lembrér and Meaney (2015) supported the statement because they primarily concentrated on socialisation when teaching Mathematics. The relationship between play and socialisation was the central focus of a study by Edo and Deulofeu (2006) who found that classroom play in Mathematics develops social interaction and communication between participants. Their statement is supported by Edo, Planas and Badillo (2009), who revealed that the relationship between play and teaching of Mathematics strengthens communication between the educator and learners. Edo et al., (2009) concluded that the learning of Mathematics using play develops interaction that increases communication and appreciation of different views from participants. Furthermore, a recent study by Rosli and Lin (2018) showed that during play activities in the mathematical classroom, children can interact with adults and their peers through verbal communication and discussions. Mathematical play in the classroom also enhances socialisation between

parents and educators. Rosli and Lin (2018) recommended that parents and educators should collaborate in creating a safe environment that can stimulate children mentally and physically. Rosli and Lin's (2018) study was useful in strengthening the researcher's position that the relationship between play and socialisation is enhanced by collaboration between stakeholders to create a safe and secure environment in the teaching of number sense to Grade 3 Learners. This study found that, generally, there is an increase in the extent of socialisation when MKOs facilitate play activities in the teaching of Mathematics. Furthermore, even when learners are engaged in play activities on their own, the learner with more knowledge can act as an MKO to other learners and this increases social interaction between peers. One of the more significant findings to emerge from this theory is that play in the teaching of Mathematics affects social interaction.

2.3 GARDNER'S THEORY OF MULTIPLE INTELLIGENCES

There is a stereotype that people who are not intelligent cannot do Mathematics. As such, it is randomly stated that for a learner to achieve in Mathematics, they need to have some level of intelligence. One of the most significant discussions in teaching and learning Mathematics is the application of multiple intelligences theory. Also, according to Karamikabir (2012), the multiple intelligences theory includes mathematical intelligence. Although the main focus of multiple intelligences theory is intelligence as a whole, the researcher focused largely on intelligence in the application of teaching and learning Mathematics.

It is commonly believed that intelligence is an innate skill. There are numerous definitions of intelligence, One of the definitions by Gardner (1999: 59) is that intelligence is a "biopsychological potential to process information that can be activated in a cultural setting to solve problems or create products that are of value in a culture". Also, according to Niroo, Nejhad and Haghani (2012), intelligence is a product of one's culture. On the contrary, Pehlivan and Durgut (2017) stated that intelligence is the ability to learn new knowledge and expand it and is not hereditary. This study adopts Pehlivan and Durgut (2017) and Šafranj's (2016) definitions. The researcher believes that culture can be used to expand an individual's intelligence as Mathematics skills are not genetic.

Different types of intelligence were proposed by different scholars such as Hajhashemi, Caltabiano, Anderson and Tabibzadeh (2018) who investigated Gardner's proposal that everyone has at least nine (9) different "intelligences": (i) Verbal-linguistic; (ii) Logical-mathematical; (iii) Visual-spatial; (iv) Bodily-kinesthetic; (v) Musical-rhythmic; (vi) Interpersonal; (vii) Intrapersonal; (viii) Naturalistic; and (ix) Existential. This study focuses on logical-mathematical intelligence because Arum, Kusmayad and Pramudya (2018) found that logical-mathematical intelligence plays a role in mathematical learning. Furthermore, Gürel and Tat (2010) and Pehlivan and Durgut (2017) revealed that individuals with logical-mathematical intelligence are good at arithmetic counting and geometric shapes, critical thinking and interpreting information. From the literature of Arum et al. (2018), Gürel and Tat (2010) and Pehlivan and Durgut (2017), the researcher understands that logical-mathematical intelligence is the intelligence that can be used in the application of teaching and learning Mathematics. As a result, the researcher expanded on logical-mathematical intelligence during teaching and learning of number sense to Grade 3 learners.

2.3.1. Logical-Mathematical Intelligence

On one hand, there is some evidence to suggest that logical-mathematical intelligence should be regarded as the ability to work with mathematical concepts when an individual is engaging in the real world. Such evidence can be seen in the description of logical-mathematical intelligence and its linkage with a particular set of skills as described by Gardner (1985). He further asserted that logical-mathematical intelligence begins with engaging with real-world activities and increases when we understand its relationship with the world's patterns. Rosli and Lin (2018) indicated that play is one of the activities that occur in the real world.

On the other hand, Arum et al. (2018) described logical-mathematical intelligence as possessed by an individual with sensitivity to logical numbers and the ability to reason. Also, Kaplan, Calp and Ozdemir (2011) outlined that logical-mathematical intelligence is the ability to think with numbers and solve mathematical problems. Drawing from the above reference, the researcher describes logical-mathematical intelligence as the skill to construct numbers, to reflect critically and logically and the ability to learn new things.

Logical-mathematical intelligence is important to educators as it is likely to have a positive impact on the teaching and learning of Mathematics. One of the important elements of logical-mathematical intelligence is shown by Arum et al. (2018) that if educators could identify the characteristics of learners who have high logical-mathematical intelligence, the process of teaching and learning Mathematics might be improved. Emmiyati, Rasyid, Rahman, Arsyad and Dirawa (2014) observed that it is important to note the level of intelligence the learner has and to be able to provide appropriate learning activities for that learner. Gordon and Browne (2011) and Woolfolk (2014) added that "multiple intelligence classes" are important because they help educators to develop their strategies, developing curricula and assessment methods based on children's culture, and priorities the individual children's intelligence. Woolfolk (2014) found that educators also need to have logical-mathematical knowledge to teach Mathematics. Referring from Gordon & Browne (2011) and Woolfolk (2014), the researcher agrees it is the responsibility of educators to expand logical-mathematical intelligence through engaging in activities such as play even though Gordon and Browne (2011) and Woolfolk (2014) were not specific about logical-mathematical intelligence.

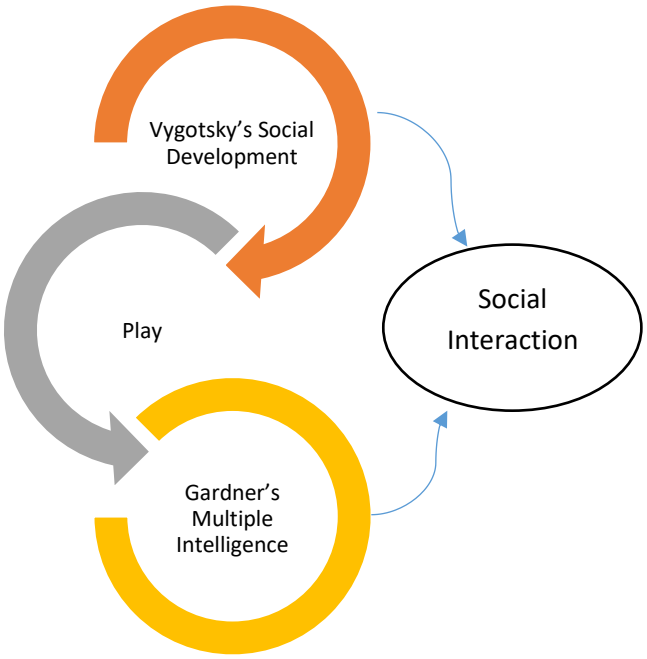


Figure 2.2 Relationship between Vygotsky's social development theory and Gardner's multiple intelligence theory

Figure 2.2 depicts the relationship between Vygotsky's social development theory and Gardner's multiple intelligences theory. The common concept that is evident in the two theories that form the framework of this study is social interaction. In this section, it was explained that Vygotsky's social development theory focuses on social interaction. Moomaw (2011) stated that play is critical as it creates social interaction on its own which is why it is included in the figure. The researcher notes that when learners are playing with one another social interaction is promoted naturally because Graven and Lerman (2014) highlighted that the "other" can be a learner as well. The researcher notes that MI theory indicates that intelligence can be expanded during teaching activities that include social interaction. Furthermore, the researcher understands that social interaction is stimulated when an educator is developing logical-mathematical intelligence during teaching and learning. In Mathematics, when learners are engaged in the activity and participating by asking and answering questions, social interaction flourishes. Therefore, the present study uses social interaction as a frame.

2.4 SECTION B: LITERATURE REVIEW

It was indicated in the introduction of this chapter that the second section presents the literature review. This enabled the researcher to be familiar with existing research and debates relevant to the topic, as well as to identify knowledge gaps in this study. To do this, the researcher identified three (3) themes from the research questions to aid the literature review for this study: (2.4.1.) the role of play in teaching number sense; (2.4.2) the use of play in teaching number sense; and (2.4.3) the types of play that can be used to teach number sense.

2.4.1 The Role of Play in Teaching Number Sense

It is a widely held view that socialisation is created through play when teaching Mathematics. This shows that the role of play in teaching Mathematics is socialisation. These views are compatible with Kermani (2017) who found that computer games are effective when accompanied by teacher facilitation and scaffolding, as this creates socialisation in the teaching of number sense. Nejem and Muhanna (2013) added that computer games in teaching Mathematics help learners to communicate, interact and develop social skills.

Literature found that socialisation is important in teaching Mathematics. Kermani (2017) found that socialisation helps to improve learners' understanding of number sense. On the one hand, Özdogan (2011) found that children use hands in play activities to understand mathematical concepts and skills. On the other hand, Rosli and Lin (2018) found that socialisation increases learners' interest in learning mathematical skills and concepts. In addition to this, Nejem and Muhanna (2013) maintained that computer games help to offer Mathematics in an interesting and fun way for learners, which makes learners interested in playing games. Ramani and Eason (2015) concurred that play builds children's interests in school subjects including Mathematics.

Richards, Templin and Graber (2014) conducted a study that revealed that play is one of the teaching strategies that develops socialisation. Although their study was not directly linked with the teaching of number sense or Mathematics, the researcher considered their findings because it shows that play socialisation. Sharma (2017) also found that teaching and learning is a process of socialisation. Sharma (2017) did not include play or Mathematics but showed a significant relationship between teaching and socialisation. Sharma's observations link with Vygotsky's social development that forms the theoretical framework of this study.

There is limited literature on the role of play in teaching number sense. Since number sense is a mathematical concept, the researcher saw it fit to review the literature on the role of play in teaching Mathematics. Dicker and Naude (2019) studied the role of play in teaching Mathematics and highlighted the role of play in young learners' developing new ideas about Mathematics. They further noted that the role of play is to help children learn about their world and form mathematical concepts. Against this background, it can be concluded that one role of play in teaching Mathematics is socialisation.

Apart from socialisation, the researcher identified another role of play linking with Gardner's theory of multiple intelligences that is one of the theories that form part of the theoretical framework of this study. This role is illustrated by Özdogan (2011) who described the play as a useful tool that enhances logical-mathematical intelligence, which assists future problem-solving within Mathematics. Educators should build a

relationship with the learners in the classroom as this can help the children to reach their full potential in mathematical learning (Özdogan, 2011).

Similarly, Arum et al. (2018) theorised that there is a need for educators to use play as a strategy to improve logical-mathematical intelligence for learners to understand patterns and relationships. Arum et al.'s (2018) theory was confirmed by Pérez, Guzmán and Gracia (2018) who used video games as a tool to improve logical-mathematical intelligence that helps with ordering, classifying, measuring, and logical thinking in Mathematics. Guided by the aforementioned, the researcher concludes that to evaluate the role of play in teaching Mathematics, it is important to understand how the play was used in the teaching of Mathematics. As a result, the researcher notes the significant relationship between the role of play and the use of play in teaching Mathematics.

2.4.2 The Use of Play in Teaching Number Sense

To review the literature on the role of play in the teaching number sense, the researcher noted that it is imperative to start with the literature on the use of play in teaching number sense globally. To realise this, the literature was sourced in two (2) regions, namely Europe and Africa including South Africa.

The criteria that the researcher set to select countries and studies in these regions were as follows:

Table 2.1: Criteria for the selection of countries and studies

Countries	• Two European countries, two African countries, and two provinces in South Africa, • The countries should have a similar ECE education system to South Africa, and • They should be studies on the use of play that were conducted about these countries in the past three (3) years.
Studies	• Empirical studies, • Conducted during the past three years, and • Focused on the use of play to teach number sense or Mathematics.

2.4.2.1. European countries

The majority of countries in Europe use the same admission requirements in ECD as South Africa (Cuartas, McCoy, Rey-Guerra, Britto, Beatriz, & Salhi, 2019). From European countries, the researcher selected Sweden and Switzerland. Both countries' ECE centres use play to teach Mathematics.

- Sweden

Sweden's ECE admission of children is similar to South Africa because they admit six-year-olds in ECD and seven-year-olds in Grade 1 (Cuartas et al, 2019). Björklund, Magnusson and Palmer (2018) conducted a study about teaching Mathematics in ECE using play-based and goal-oriented practice and reported on the actions educators take when using play to teach Mathematics and the opportunities that are created for learners through different ways of teaching. For this study, the researcher focused on the findings related to the lines of action used by educators when teaching Mathematics in play. The study was conducted using authentic documentation to explore how preschool learners and educators engage in different types of play with different content areas in the teaching of Mathematics. The participants were learners and nine (9) educators from different ECE centres. Björklund et al. (2018) highlighted that an educator's involvement is important in play when teaching Mathematics. From this finding, the researcher notes that educators' involvement in play strengthens socialisation. Linking with the theories framing this study, the results of Björklund et al.'s (2018) study are aligned with the role of MKO in Vygotsky's social development theory. Björklund et al. (2018) emphasised that educators play a vital role when guiding play.

- Switzerland

ECEs in Switzerland develop skills through a stimulating playing and learning environment that is similar to South Africa (European Commission, 2020). This study from Switzerland was selected because it is empirical and was conducted in the past three (3) years. The study of Vogt, Hauser, Stebler, Rechsteiner and Urech (2018) was about the deployment of different approaches from an educator-led approach to a play-based one in aiding mathematical competency. In this study, educators used

semi-structured interviews to gather views on the interventions. The participants were 35 ECE educators and 324 six-year-old learners who chose between educator-led approach or play-based approach using the card and board games. Their study revealed that educators were satisfied with play-based interventions because they motivate children's learning and increase interest. They further indicated that playing card and board games is effective for all learners with different levels of logical-mathematical intelligence. Against this background, the researcher remarks that the play-based approach heightens logical-mathematical intelligence. Associated with the theoretical framework underpinning this study, the results of Vogt et al.'s (2018) study are in line with logical intelligence in Gardner's multiple intelligences theory wherein they highlighted that card and board games were used by learners with different logical intelligence levels.

2.4.2.2 African countries

In Africa, there schools for ECE are found in villages, rural and urban areas (Mwamwenda, 2014). From African countries, the researcher selected Nigeria and Kenya, as in both countries the ECE institutions use play to teach Mathematics.

- Nigeria

According to Obiweluozor (2015), Nigeria's ECE admission of learners is similar to South Africa because they admit six-year-olds in their ECE programmes. Dele-Ajayi, Strachan, Pickard and Sanderson (2019) conducted a study about the use of a digital game called Speedy Rocket to teach Mathematics in Nigeria. The study used action research in a case study where questionnaires and observations were used to determine if the Speedy Rocket game can be used to stimulate interest and engagement in teaching Mathematics. They state that the participants were sixty (60) learners (aged 8-11 years) from three primary schools, each located in Ado-Ekiti state, Southern Nigeria. The findings revealed that playing of Speedy Rocket increased attitude and enjoyment of learners in the Mathematics classroom. They also found that playing Speedy Rocket multiplied children's motivation, enthusiasm, and excitement in the mathematical classroom. They further aver that Speedy Rocket assisted in overcoming the barrier of communication in the classroom as learners engage and interact with one another.

Against these findings the researcher perceives that the use of Speedy Rocket enhances socialisation. With cross-reference to the theoretical framework supporting this study, the outcome of Dele-Ajayi et al.'s (2019) study is reconcilable with the relationship between play and socialisation.

- Kenya

Bietenbeck, Ericsson and Wamalwa (2017) found that ECE entry in Kenya is at six years of age. This is the same as South Africa. The study of Tsindoli, Ongeti, and Chang'ach (2018) was conducted using indigenous play to teach Mathematics. They conducted a study on integrating indigenous knowledge within the curriculum of Mathematics for primary schools in Kenya. The study used a mixed-method approach where questionnaires, observation schedules, and focus group discussions were used to identify the extent to which existing indigenous knowledge practices are applied in the teaching of mathematical concepts. The participants were six (6) Mathematics educators and six (6) learners. Their findings demonstrated that indigenous play could be applied in the teaching of Mathematics. Tsindoli et al. (2018) further stated that educators played an important role in explaining indigenous play such as "*kora*" which is illustrated in Figure 2.3 to teach various mathematical concepts.

Figure 2.3: "*Kora*" (Kenyan traditional game)

Furthermore, they reported that educators create a linkage between indigenous play and teaching of mathematical concepts to ensure that learners understand

Mathematics. From their findings of, the researcher observed that the role of educators is to link indigenous play with the teaching of Mathematics. Associated with the theoretical framework of this study, the findings of Tsindoli et al. (2018) showed that the role of MKO is to give guidance in indigenous play when teaching Mathematics. The game illustrated in Figure 2.3 can be played by two or more learners. It teaches learners how to count, add, subtract and multiply.

2.4.2.3 South Africa

The researcher envisaged collecting data for this study from educators working in the Limpopo Province of South Africa. From the other eight (8) remaining provinces, the researcher selected the Western Cape and Gauteng because they met the set criteria because recently published studies had been conducted at schools in the provinces.

- Western Cape

Western Cape was selected by the researcher because there was a recent study conducted by Mntunjani, Adendorff and Siyepu (2018) about the educators using manipulatives (resources) in teaching number concepts. They used an interpretive case study design where primary data was collected through observations and interviews about the use of manipulatives to teach number concepts. The participants were five (5) FP educators teaching Grades 1 to 3 at two (2) schools in the Western Cape of South Africa using observations. Furthermore, they revealed that when learners used manipulatives, they were more active and interacted more intensively with the content. From their findings, the researcher concludes that the use of manipulatives in exploratory play such as modelling increases socialisation. Learners can be given a range of items (such as plastic shapes) for playing a game of sorting and matching for colour, shape, and size. The team with the highest score wins the items to use for the next play. In line with the theoretical framework in this study, Mntunjani et al. (2018) affirmed that there is a relationship between the use of mathematical resources and socialisation. With that in mind, it can be noted that mathematical resources are important in exploratory play on modelling as they promote interaction between learners that has the potential to stimulate socialisation.

- Gauteng

In this province, the researcher found a study by Omidire, Ayob, Mampane and Sefotho (2018) to be relevant because they explored the use of non-locomotor play to teach Mathematics. They investigated the use of structured movement to teach Mathematics and language concepts. The study used observations, analysis of worksheets, visual data and semi-structured interviews in a qualitative exploratory case study design to explore the extent to which non-locomotor play can be used to teach Mathematics and language concepts. Twenty (20) Grade R learners participated with one (1) ECE educator and one (1) head of department (HOD). The research findings found that the bean bag toss game used to teach learners the visual form of size and measurement generated learners' social and cognitive development. This game can be played by two (2) to four (4) learners whereby team members stand on opposite ends of a box and may toss the bean bag from either side of the box. The game is over when one team scores 21 points, but the victorious team must win by two (2) points. They discovered it once more that learners enjoyed the bean bag toss game and the element of competing which created teamwork and group participation, which contributed to building social skills in the teaching of Mathematics and language.

From these findings, the researcher highlights that the bean bag toss game improves socialisation. In terms of the theoretical framework of this study, their study showed the relationship between play and socialisation in the teaching of Mathematics. Omidire et al. (2018) emphasised that teamwork and group participation was encouraged and social skills were developed when playing the bean bag toss game in the teaching of Mathematics and language.

2.4.3 Types of Play that can be used to Teach Number Sense

It was shown in the previous section that various researchers researched how various games assisted in teaching Mathematics. In this section, the researcher discusses different types of play that can be used to teach number sense. So far, however, there has been little discussion from the literature on the types of play that can be used to teach number sense. As a result, the researcher reviewed the literature on the types of play that can be used to teach mathematical concepts since number sense is embedded in mathematical concepts. The researcher acknowledges that there are many types of play but for this study, she chose to focus on some of the types of play

(Dicker & Naude, 2019), namely, physical, construction, exploratory, creative and wordplay. These types of play can be played in both an indoor and outdoor setting.

2.4.3.1 Physical play

Dicker and Naude (2019) and Wonderly (2017) stated that physical play involves all kinds of physical movements. Wonderly (2017) pointed out that physical movements develop gross and fine motor skill while Dicker and Naude (2019) revealed that physical movements included locomotor and non-locomotor movement. The researcher understood from these studies that locomotor play can only be played outside the classroom because it needs a lot of space while non-locomotor movements can be played both outside and inside the classroom (Dicker & Naude, 2019)

It is a widely held belief that physical play can benefit from the teaching of Mathematics. This revelation is under Dicker and Naude (2019) who demonstrated that playing frog jump can benefit learners to discover problem-solving skills when they know how many frog jumps are needed to move from one point to another. Banda (2018) found that physical play helps to stimulate logical thinking, planning, analysing, and problem-solving skills in the teaching of Mathematics. Furthermore, Banda (2018) established that physical games develop conceptual and perceptual skills that help learners to build interpersonal relationships as they talk to each other when they play and remind each other of the rules of the game.

Omidire et al. (2018) also found that physical play can be used in the teaching of Mathematics and language and enhances social and cognitive development when learners are engaged in tasks of listening, seeing, doing and practically applying the concepts of Mathematics and language. Omidire et al. (2018) further suggested that structured movement activities benefit physical development that impacts learners positively.

Furthermore, Bose and Seetso (2016) proposed that educators ask learners questions during play to assess conceptual knowledge, and that communication helps to develop the link between play and socialization.They nominated "*Diketo*" in Setswana/Sepedi language as game non-locomotor play. According to them, "*Diketo*" is a game played by one or two learners at the same time. Five to ten small stones are collected with a

bigger one called “mokino” and they are put into a small hole in the ground. Learners use one hand to throw up “mokino” and scoop as many remaining stones from the hole with the same hand while the “mokino” is still up in the air and then catches the “mokino” again with the same hand (Bose & Seetso, 2016). Furthermore, they explained that the learner counts stones in groups as they are playing. These games benefit learners with grouping, measuring, and counting skills when the educator asks questions. The researcher notes that the “*Diketo*” game can develop learner’s eye-hand coordination when learners are throwing and catching stones and the resources such as stones can be accessed freely from their immediate environment.

From the studies cited, the researcher notes that physical play enhances socialisation. The findings of Banda (2018) showed that in physical play, learner’s build relationships that increase socialisation. As highlighted by Bose and Seetso (2016), learners play leapfrog in groups of five (5) which creates interaction. Lastly, they emphasized that “Diketo” stimulates socialisation when played by one or two children. Furthermore, they proposed that educators ask learners questions during play to assess conceptual knowledge, and that communication helps to develop the link between play and socialization.

2.4.3.2 Construction play

As highlighted by Dicker and Naude (2019), learners in construction play are creating, reasoning and solving problems that are important in learning Mathematics. More recently, Reikerås (2020) mentioned that learners usually use building blocks such as wood bricks and DUPLO blocks in construction play. The finding is consistent with Dicker and Naude (2019) who stated that learners building a tower with wooden blocks will learn mathematical concepts when they know how many blocks are used and learn the shapes of the blocks.

Construction play is important because, when learners construct blocks, this develops visual perception, gross and fine motor skills (Pirrone, Nicolosi, Passanisi & Nuovo, 2015). Rosli and Lin (2018) also stated that construction blocks help to enhance eye-to-hand coordination and helps to teach addition, subtraction, multiplication, and division. The findings of Rosli and Lin (2018) is consistent with the findings of Ramani and Eason (2015) which showed that spatial skills are developed when putting together a puzzle, and geometry is developed when building with blocks. The

researcher notes that construction play is integrated with non-locomotor movement in physical play.

Pirrone et al. (2015) found that learners learn the meaning of size, shape, length, weight, capacity and balance by touching manipulating blocks. Furthermore, Ramani and Eason (2015) noted that communication and interaction are developed when learners use blocks to build a house.

However, Paek (2012) commented that it is not easy for young children to connect concrete objects such as blocks, beans and sticks on their own. Mntunjani et al. (2018) agreed with Paek (2012). They suggested that learners need direction from educators in using constructing materials. Also, Ogunyemi and Ragpot (2015) indicated that the role of an educator is to give guidance in construction play. The researcher takes note that construction play usually uses cost resources that can be used during a lesson.

From the reports, the researcher established that there is a relationship between the MKO and construction play. Mntunjani et al. (2018) and Ogunyemi and Ragpot (2015) posited that the role of the MKO is to give guidance in construction play. Again, the researcher notes that construction plays a role in socialisation because when learners are constructing blocks they interact with one another and communicate (Ramani & Eason, 2015).

2.4.3.3 Exploratory play

In 2009, the National Council for Curriculum and Assessment (NCCA) reported that children use their senses in exploratory play to find out what things feel like and what can be done with them. A likely explanation for exploratory play is that learners explore the possibilities of unfamiliar things (Dicker & Naude, 2019). This kind of play can strengthen learner's ability to experiment with tools that are required for playing and learning (Reikerås, 2020).

There is some evidence to suggest that children explore things in their environment to learn mathematical concepts. This affirmation is consonant with Dicker and Naude (2019) who indicated that a child can, for example, use a whisk to learn a mathematical concept.

Frye, Baroody, Burchinal, Carver, Jordan and McDowell (2013) invented a game called "*Numerals and Dots game*". In this game, they observed that half of the cards needed for this game should have a number and dots to represent the amount on one card and the other half of the cards have pictures of collections of objects on one side. The other side of each card is blank. Cards with numbers and dots are separated from cards with pictures and all are placed face down on a surface. A player chooses one card from the numeral cards set and another one from a set of pictures. If there is a match, then the player keeps those cards. The game is over when there are no more matching cards. The player with the most cards wins the game. Frye et al. (2013) concluded that learners acquire numeral recognition from this exploratory game.

Furthermore, Dicker and Naude (2019) highlighted that it is the responsibility of an educator to create a safe and secure environment when learners are exploring materials. They posited that the role of the MKO in exploratory play is to create a safe, secure and challenging mathematical environment. From Dicker and Naude's (2019) research, the researcher notes that there is a relationship between the MKO and exploratory play.

2.4.3.4 Creative play

It is believed that creative play involves the ability to change raw materials into new products while playing. Dere (2019) suggested that educators should encourage learners to participate in creative games and value the final products that are made. Similarly, Dicker and Naude (2019) found that learners in creative play use natural materials to create new products in a creative way. Wilmot and Schäfer (2015) found that learners can play games that include creative skills such as painting, cutting and pasting, modelling or drawing to express their meanings and understanding of mathematical concepts. Gordon and Browne (2011) posited that creative play can happen in any setting, regardless of lack of financial resources.

It is a widely held view that creative play plays a role in the teaching of Mathematics. This assertion is in line with Wilmot and Schäfer (2015) who posited that the role of a creative classroom is to provide learners with opportunities to ask questions, develop their ideas, create a hypothesis and work as a team which helps in teaching Mathematics.

Wilmot and Schäfer (2015) revealed that the role of creativity is to increase learner's interest in learning Mathematics. They further suggested that educators should increase the interest of learners by engaging and being creative too; for example, to help with counting skills an educator could help learners to arrange chairs in a line to create a seating arrangement or learners could draw cards with different numbers of ladybugs (Ramani & Eason, 2015); learners would be creative with other learners by using all their shoes to represent certain patterns or extend the patterns (Dicker & Naude, 2019);.

The Ministry of Education, Youth and Information, Jamaica (2016) described a creative game to teach Mathematics is one where learners guided by the educator to draw four boxes on the ground in a four-by-four foot diagram. One learner enters each box while others wait for their turns around the box. The learner outside the square throws a ball to the first player in the square who bounces it to the second player without holding the ball or stepping out of their square. Each player needs to successfully bounce the ball four times with his peers counting and monitoring the number of times. Whoever fails to do so steps out of their box. The thrower takes their place. Another thrower is selected. When each player in the four boxes has successfully bounced the ball four times, they shout 4 x 4 equals 16. Then all learners change places and four new players step into each box. The game continues until all the learners have had a chance to enter the square. The role of this game is to teach learners shapes, counting skills and multiplication (Ministry of Education et al. 2016).

Moreover, Wilmot and Schäfer (2015) stated that the role of educators in creative play is to provide learners with various interesting materials and encourage learners to use them. Dicker and Naude (2019) supported Wilmot and Schäfer (2015) by explaining that it is an educator's role to structure an inviting environment to teach mathematical concepts.

With this evidence, the researcher notes that creative play expand the logical-mathematical intelligence of learners. This is obvious from Wilmot and Schäfer's (2015) findings that in a creative classroom, learners tranform conceptual knowledge by asking questions, generating new ideas, drawing conclusions, collaborating and co-constructing their knowledge of Mathematics. The researcher further understands that the role of MKO is to help in expanding logical-mathematical intelligence by

providing learners with a range of interesting materials (Wilmot & Schäfer, 2015) and by structuring an inviting environment (Dicker & Naude, 2019).

2.4.3.5 Wordplay

It is commonly assumed that wordplay helps to develop mathematical vocabulary. This is illustrated by Dicker and Naude (2019) who stated that learners develop mathematical vocabulary and learn new concepts through wordplay.

Frye et al. (2013) observed that wordplay helps learners to label items according to their appropriate number word. For example, they stated that when learners can recognise various quantities labelled with the same number word and other quantities with other number words, they develop the skill of counting.

Furthermore, Frye et al. (2013) showed that wordplay helps learners to develop numeral recognition and corresponding quantities when playing a game called "*Match numerals with corresponding quantities".* The educator needs one set of 20 cards: 10 cards with number symbols from 1 to 10 along with the corresponding number names. Both sets of cards are placed face down. A player chooses one card from the number symbol card set and one card from the number name set. The player keeps cards if they match. Play continues until all cards are matched with one another and a player with the most matching cards wins the game (Frye et al., 2013). The researcher suggests that the educator can create these resources used in this type of wordplay from flashcards and sheets.

According to Busch (2021), learners can develop mathematical vocabulary by playing with dominoes. He showed that dominoes help learners to recognise the word bigger and smaller in the game. The educator attaches a sticker with the word "more" and others with the word "less" on the back of dominoes. Learner's place all dominoes face down, each learner flips two dominoes over and place the two next to each other to create a four-digit number. For a small number, the smallest number will go in the front. The learner with the winning number keeps the dominoes (Busch, 2021). The researcher understands that this game can be played after a lesson when the learner understands the difference between more and less.

Dicker and Naude (2019) showed that mathematical vocabulary can be derived from mathematical songs, music, rhymes and verses. Similarly, Bose and Seetso (2016)

the use of songs and rhymes can teach science and Mathematics concepts to young children. Rosli and Lin (2018) observed that learners can explore mathematical concepts by singing and hearing through music. For example, Bose and Seetso (2016) explained that the rhyme called "*Sila Sila Mmele Mele*" in the Setswana language is about using two stones to pound corn. From this rhyme, learners learn words such as big, small, rough and smooth. Another study by Rosli and Lin (2018) stated that song with the lyric "*Once I Caught a Fish Alive*" educators learners counting.

From the types of games played as wordplay, learners play with one another. Frye et al. (2013), for example, showed that learners in "*Match numerals with corresponding quantities"* play in groups. Similarly, Busch (2021) revealed that learners play using dominoes in small groups. Sharma (2017) showed that teaching on its own creates socialisation while teaching using play strategy enhances socialisation (Richards, Templin & Graber, 2014). From the literature, the researcher concludes that wordplay boosts socialisation in the classroom.

2.5 CHAPTER SUMMARY

This chapter has presented the literature concerning the research topic. It has delineated the theoretical framework underpinning this study, namely, Vygotsky's social development theory and Gardner's theory of multiple intelligences. It has also furnished an overview of what other researchers have found on the role of play in teaching number sense to Grade 3 learners. The researcher's reflection on the literature reviewed concerning the role of play in teaching number sense revealed that there is a significant relationship between teaching number sense using play strategy and socialisation. The next chapter discusses the research methodology employed for this study.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 INTRODUCTION

The previous chapter addressed the review of the literature relevant to the study to explore the role of play in teaching number sense to Grade 3 learners. This chapter explains the research design and methodology of the study which includes the selection of participants, data collection tools, the process of collecting data, data analysis, measures of trustworthiness concludes with ethical measures.

3.2 RATIONALE FOR EMPIRICAL RESEARCH

Dan (2019) asserted that researchers who conduct empirical studies use systematic collection and analysis of data to acquire knowledge especially observation in qualitative research approach. Blog (2020) indicated that in an empirical study, data is obtained from evidence-based methods, namely, through observation or scientific data collection.

It is against this background that in an empirical study, the researcher can collect data from interviews and observation to enquire knowledge. This study used an interpretivist paradigm to collect data. Since interpretive researchers collect data on their own while interacting with researchers, the researcher argues that this current study is empirical. The researcher used semi-structured interviews to get the views and experiences about the use of play when teaching number sense. The researcher used non-participant observation to observe educators and learners interacting in teaching and learning of number sense through play.

This study used the qualitative research methodology to solve the research problem systematically. As indicated by Rajasekar, Philominathan and Chinnathambi (2013) and Kivunja and Kuyini (2017), research methodology is a systematic way of solving a research problem. Rajasekar et al. (2013) stipulated that research methodology helps in solving problems systematically and it helps the researcher to address the chosen problem. Kivunja and Kuyini (2017) also found that the research methodology uses logical and flow of systematic processes in conducting a project to gain knowledge about the research problem.

The research methodology of this chapter shows how the researcher selected a suitable research design and data collection methods for this study to achieve the research aim and objectives (Long, 2014). Figure 3.1 outlines the research methodology of this chapter.

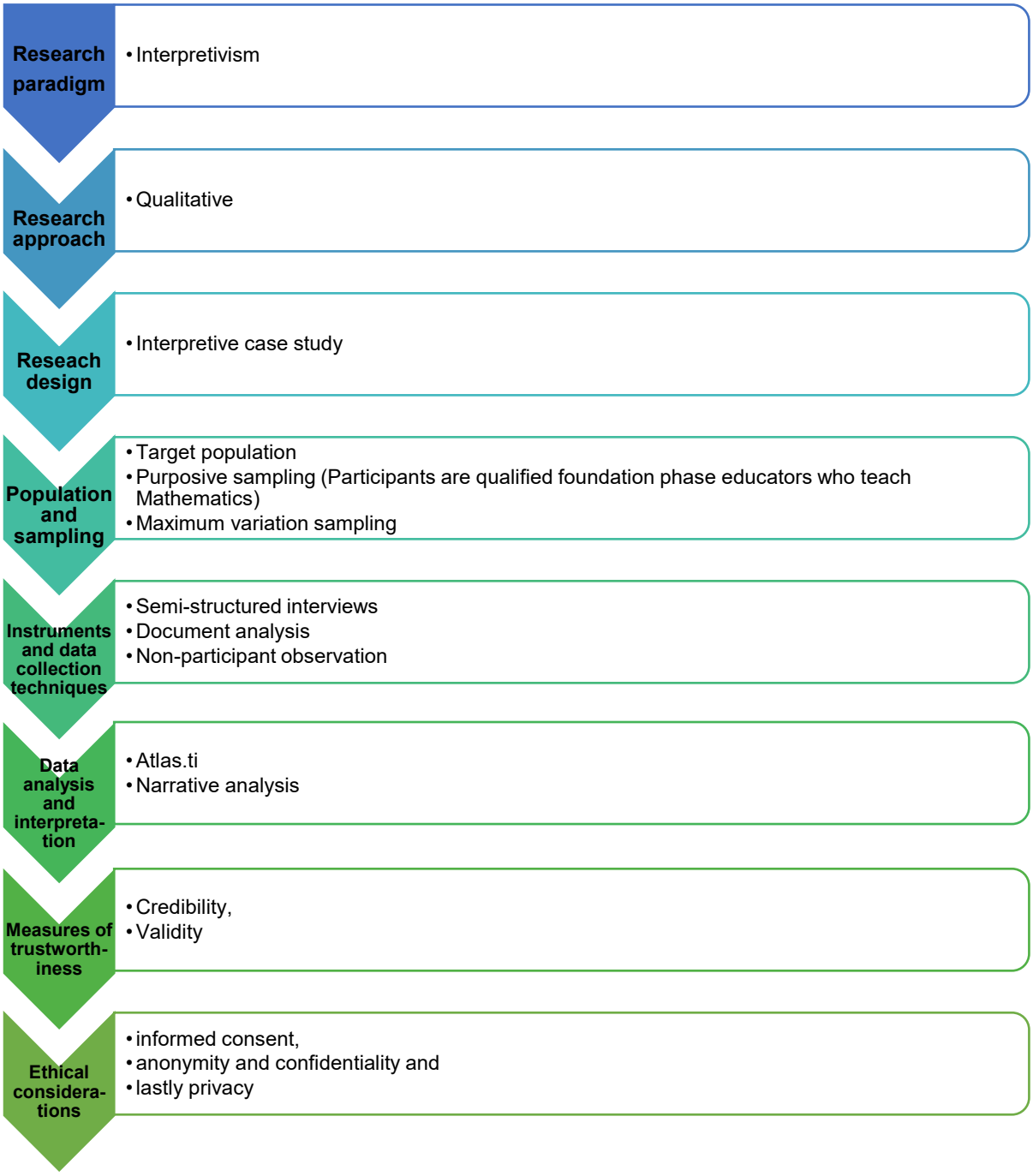


Figure 3.1: The research methodology

This chapter first delineated the paradigm which influenced this study. The paradigm was linked with the suitable research approach.

3.3 RESEARCH DESIGN

In Chapter 1, the researcher indicated that different research designs in a qualitative approach are explained in full detail in this Chapter. Table 3.1 below presents different qualitative research designs,

Table 3.1: Presentation of different research designs

Research design	Description
Phenomenology	Phenomenology is the study of phenomena. Phenomena may be events, situations, experiences or concepts. Phenomenology is a way of describing something that exists as an integral part of the world in which we are living.
Ethnography	Ethnography is usually used when the research includes cultural parameters such as geographical, religious, tribal, shared experiences and lifestyle.
Grounded theory	This is a type of qualitative research methodology that allows theory/theories to emerge from the data that is collected
Case study	A case study may be qualitative or quantitative, a case study can be used by researchers to explore issues to understand underlying principles.

(Astalin, 2013:119-123)

Based on the information presented in Table 3.1 and the description put forward by Astalin (2013), the researcher viewed the case study design as suitable for this study. This selection was also guided by Harrison et al. (2017) who affirmed that a case study is usually used when researchers aim to explore issues especially when human behaviour and social interaction is involved. From the aforementioned, the researcher aimed to explore the role of play in teaching number sense to Grade 3 learners.

Like other interpretive case study researchers, the researcher collected data on her own so that she could interact with participants to explore in-depth the role of play in teaching number sense to Grade 3 learners, as recommended by Elbardan and Kholeif (2017) and Ponelis (2015). Elbardan and Kholeif (2017) remarked that when interpretive case study researchers collect data on their own, this helps them to interact closely with the participants to explore issues in-depth.

3.3.1 Research Paradigm

For this study, a research paradigm means how the researcher views their world. The paradigm of this study is guided by scholars such as Kamal (2019) and Kivunja and

Kuyini (2017) who suggested that the research paradigm is the researcher's beliefs and the way they view their world. Kamal (2019) noted that the research paradigm is the researcher's beliefs and values about the world and the way they operate within the world. In addition, Kivunja and Kuyini (2017) indicated that research paradigm defines the researcher's worldview and establishes the beliefs that shape how the researcher views and interprets the world. Against this backdrop, the researcher notes that the research paradigm is how an individual views the world and the ability to interpret it.

Drawing from Pessu (2019); Rehman and Alharthi (2016) and Siddiqui (2019), the researcher learnt that how individuals view the world in research is based on ontology, epistemology, methodology and methods. With a similar view is Pessu (2019) who attested that the research paradigm is a set of beliefs that are based on the assumption of ontology, epistemology and methodology. In addition, Siddiqui (2019) clarified that these assumptions depend on the theoretical framework underpinning the study and different approaches. It is against this background that the researcher noted the advice put forward by Rehman and Alharthi (2016) and Siddiqui (2019). The research methodology of this study was aligned with the theoretical framework made up of by Vygotsky's theory of social development and Gardner's multiple intelligence which were discussed in detail in Chapter 2.

The main research paradigms are positivism, interpretivism, feminism, critical theory and post-positivism. An overview of these paradigms is provided in Table 3.2.

Table 3.2: The differences between the research approaches

DIFFERENCES AMONGST THE APPROACHES TO RESEARCH					
	Positivism	**Interpretivism**	**Feminist**	**Critical**	**Post-positivism**
Reason of research	**Predict** Discover natural laws so people can predict and control events	**Understand** To understand and describe meaningful social action	**Empower** To empower and radically change women socially, personally and politically	**Emancipate** To smash myths and empower people to change society radically	**Deconstruct** To demonstrate the ways language obfuscates
Nature of social reality	Reality is objective and 'found'	Reality is subjective and constructed	Reality is socially constructed oppressions to regulate women	Reality is subjective and constructed based on issues of power	Reality is ultimately unknowable
Nature of truth	There is one truth that can be found	Truth is multifaceted	Truth is multifaceted and can be found in women's experiences	Truth is multifaceted and constitutes a system of socioeconomic power	Truth is socially constructed based on issues
Nature of discourse	Discourse is structured	Discourse is dialogic	Discourse is gendered	Discourse is embedded in rhetorical and political purposes	Discourse is inseparable from its subject and it radically contingent and vulnerable
Nature of communication	Transmission	Transaction	Transgressive	Decision-making	Challenging the nature of communication
Epistemology	What is true? What can we know?	What can we understand?	What works against women? What must we do?	What is just? What can we do?	Is there a truth? What constitutes truth?

The researcher compared and contrasted the paradigms as presented by Table 3.2 and found interpretivism was suitable for this study because interpretivists believe that researcher can explore their world and find truth from participants. Therefore, the researcher explored and described the role of play from the views and perspectives of educators when teaching number sense to Grade 3 learners.

By getting educators' views and perspectives, the researcher aligned her interpretivist role with Pulla and Carter (2018) who suggested that interpretivism invites the researcher to investigate the truth by exploring through an understanding of human behaviour, interactions and society. In addition, Thanh and Thanh (2015) asserted that interpretivist researchers explore their world by interpreting the understanding of individuals.

The researcher used a qualitative approach as a plan and procedure to guide the selection of methods of data collection, analysis and interpretation because it is usually occurring in a natural setting. This was advised that interpretive researchers employ methods that generate qualitative data (Rehman & Alharthi, 2016). This is supported by Dean (2018) who revealed that the interpretivist paradigm is frequently termed qualitative inquiry, naturalistic paradigm or qualitative research.

3.3.2 Research Approach

As indicated when concluding the previous section the researcher selected a qualitative research approach. Daniel (2016) stated that the qualitative approach interprets human thought and behaviour in a social context and includes different experiences to understand and appreciate individuals' views. In this study, a qualitative research approach was used to interpret the views of Grade 3 educators who use play to teach number sense.

Similarly, Mohajan (2018) indicated that a qualitative research approach is a form of social action in which individuals interpret data to make sense of their experiences to understand social reality. The aim of the qualitative research approach was also mentioned by Siddiqui (2019) in that in qualitative research, a researcher should understand what is happening in a social context. The setting of this study was public primary schools where teaching and learning activities occur.

3.4 RESEARCH METHODS

There should be a relationship between research methodology and research method (Igwenagu, 2016; Long, 2014). Igwenagu (2016) mentioned that research methods are derived from research methodology. Long (2014) agreed that the selection of research methods is guided by the research methodology. The selection of participants was directed by a qualitative approach while the choice of research instruments used to collect data was guided by the interpretive case study design.

3.4.1 Selection of Participants

In this study, the research population was educators teaching Mathematics in Grade 3 in the FP. Kestenbaum (2019) and Majid (2018) stated that research participants are drawn from a population. According to Kestenbaum (2019), research participants belong to a study population. Majid (2018) concurs with Kestenbaum (2019) that research participants are found in a population of interest.

Since the population was a large group of potential participants, the researcher was guided by Asiamah, Mensah and Oteng-Abayie (2017) and sampled participants for the target population because she noted that many educators teach Mathematics in Grade 3. Alvi (2016) presented different types of sampling procedures such as volunteer, convenient, purposive, quota, snowball, matched and genealogy sampling, From these, the researcher selected purposive sampling because it seeks to find truth from participants with the same criteria and educators with same knowledge helped to provide valid data that was consistent with the literature (Etikan & Bala, 2017; Issaka, 2018). Etikan and Bala (2017) stated that purposive sampling samples participants with the same kind of work experience such as those that specialise in teaching Mathematics in Grade 3. Etikan and Bala (2017) further maintained that sampling participants with the same experience helps to improve the confirmability and trustworthiness of the study. As advised by Asiamah et al. (2017), that there should be specific criteria for the target population from which participants are selected. In this study, the criteria of participants included age, work experience, and qualifications.

Six (6) educators from three (3) public primary schools participated in this study, which meant that two participants were selected from each school. The researcher was not teaching in any of those three schools. The schools were near the school where the

researcher was teaching. The schools were named School 1, School 2 and School. These schools are located in the Capricorn South District in the rural areas of Limpopo Province. The LoLT in the Foundation Phase is the home language of Sepedi. As such, educators use Sepedi to teach Mathematics in Grade 3. The small size of the sample dictated that the researcher should use maximum variation sampling as recommended by List (2004). Maximum variation sampling was suitable for this study because the researcher selected six (6) educators according to their work experience of teaching Mathematics in Grade 3. The researcher's interest was in exploring the role of play in teaching number sense to Grade 3 learners.

3.4.2 Data Collection

A considerable amount of literature has been published on research instruments that are used to collect data in a research study such as Annum (2017), Canals (2017), and Insights (2020). Annum (2017) reported that research instruments are tools for data collection. Canals (2017) agreed that research instruments are tools for gathering data. Furthermore, Insights (2020) described that a research instrument is a tool used to obtain, measure and analyse data.

The researcher selected an interpretive case study design for this research noting that it uses specific research instruments such as document analysis, archival records, interviews, focus group discussions, observations, and physical artefacts (Yin, 1994). The researcher used interviews, document analysis, and observations. Interviews were used to solicit the views and experiences of educators on how they use play in teaching number sense to Grade 3 learners. Document analysis was used to corroborate educators' responses from the interviews with the planning and implementation of their lesson plans. During the observations, the researcher triangulated the data from the interviews with the data from the documents to verify the relationship between the planned learning activities with what is implemented in the classroom. Most importantly the researcher observed the role of play in the teaching and learning of number sense.

3.4.2.1 Interviews

In this study, the researcher used individual interviews to obtain the views and experiences of educators about the use of play in teaching number sense to Grade 3

learners. Trigueros, Jaun and Sandoval (2017) stated that interviewing is a process where researchers ask questions and get answers from participants using conversation. Interviews can be carried out face-to-face or through remote media (Simister, 2017). This study conducted face-to-face interviews while observing 1.5 metres of social distancing to comply with the national Covid-19 Level 3 lockdown regulations. The researcher selected semi-structured interviews with open-ended questions to gather educators' views and experiences on the use of play in teaching number sense to Grade 3 learners. The use of semi-structured interviewing in an interpretive case study was advised by Simister (2017) because it allows the researcher to ask open-ended questions.

Asking open-ended questions in this study helped the researcher to collect in-depth data. DeJonckheere and Vaughn (2019) affirmed that semi-structured interviews in a qualitative case study help to collect in-depth data through open-ended questions. The researcher acknowledged that it was her role to explore questions in greater depth. The researcher developed an interview schedule (Appendix I) with open-ended questions but there were also follow-up questions that were not included in the schedule. The follow-up questions depended on the participants' responses that helped to gather in-depth data. The interview sessions took ten (10) minutes for each educator. The researcher used an interview schedule to make sure that she was asking correct questions to Grade 3 educators.

The researcher used audio recording during the semi-structured interviews. Evangelinou-Yiannakis (2017) and Jong and Jung (2015) demonstrated the effectiveness of audio recording during interviews. Evangelinou-Yiannakis (2017) advised that audio recordings are effective because they allow transparency and they allow the researcher to check the accuracy and integrity of the data. Jong and Jung (2015) stated that audio recording is effective during interviews because it can capture detail and retain an accurate and complete record of the analysis interview. It further captures the tone and emphasis put on certain statements made by participants during the interviews. The researcher asked participants for consent to the recording before interviews and maintained the anonymity of the participants throughout the process.

The researcher explained that the participation was voluntary and assured participants that they could withdraw from the study at any time without providing reasons. The

researcher gave participants an information sheet that explained the intention of the study, the role of participants, and reasons for giving their consent to participate. The researcher also allowed participants to ask questions to understand what was expected from them. All six (6) participants were willing to participate in the study as they signed consent forms. The researcher explained that the interview session would be recorded and gave the reasons for recording. The researcher guaranteed the educators that their identities would be kept anonymous and would not be disclosed anywhere in the study. The researcher clarified that if any educator did not feel comfortable during the interview session, they had the right to withdraw and their data would not be used in the study. All participants agreed to a recording by signing consent forms.

3.4.2.2 Document analysis

As part of document analysis, the researcher scrutinised lesson plans from educators to understand how they use play in teaching number sense to Grade 3 learners. Bowen (2017), Cardno (2018) and Cardno, Rosales-Anderson and McDonald (2017) advised that it is the role of the researcher to analyse and interpret documents. Bowen (2017) remarked that document analysis is a procedure for evaluating documents by the researcher to give voice and meaning from them. The researcher designed a document analysis tool that assisted in gathering relevant data from documents to help answer the research questions. The document analysis tool is attached as Appendix J.

The researcher requested copies of lesson plans, learner's classwork books, and workbooks from the Grade 3 educators and corroborated educators' responses from the semi-structured interviews about the use of play in teaching number sense. The researcher asked permission from parents and learners for obtaining learners' documents. Parents signed consent forms for their children (Appendix G and N) while learners signed assent forms (Appendix H and O). Educators were informed that they had the right not to hand over documents to a researcher if the parents did not consent. All parents signed consent forms for their learners. The researcher requested lesson plans, learner's classwork books, and workbooks from educators after the observation session. The educators were advised to remove any names on the documents and replace them with pseudonyms before sending them to the researcher. Using a

correction pen, the educators removed the name of the schools from the school stamp as well as the school address.

3.4.2.3 Observations

According to Kivunja and Kuyini (2017), interpretive case study observation believes in multiple truths that makes single reality weak. This study uses multiple cases to make their reality through meanings and interpretations. Interpretive case study observation was used in this study to explore the role of play when educators are teaching number sense to Grade 3 learners. The researcher collected in-depth data by directly interacting with educators to observe the use of play in the teaching and learning of number sense to Grade 3 learners. This approach is supported by Crowe, Creswell, and Robertson (2011) and Elbardan and Kholeif (2017). The researcher designed an observation schedule (Appendix K) that was used to record information that later assisted the analysis of primary data. Rashid et al. (2019) affirmed that interpretive case study observation requires a researcher to have a step-by-step guide to conduct formal observations.

In this study, the researcher observed and recorded information without participating in the activities to avoid data contamination. Therefore, the researcher was a non-participant. This is endorsed by Trigueros et al. (2017) who reported that the role of non-participant is to record information without participating in the activities.

Interpretive case study observation was suitable for this study because the researcher wanted to observe the whole process step-by-step, and hear the exact words spoken, and view the type of play that educators use to teach number sense. The method allowed the researcher to observe how to play was used to teach number sense, and gauge educators' feelings from their speech, gestures and facial expressions. The researcher made an appointment with educators to observe them during their lessons. Because of the Covid-19 national Level 3 lock down, the researcher observed educators and learners from 1.5 metres from their play setting. The researcher observed each educator for fifty (50) minutes.

3.4.3 Data Analysis

Data analysis was viewed by Pérez (2019) as a process of examining data by using logical and analytical reasoning. Pérez (2019) further posited that the data can be

analysed through methods and techniques such as content analysis, narrative analysis and grounded theory. The researcher used narrative analysis to break down data and created categories for analysis The data is presented in full text. It was suggested by Hammond (2019) that narrative analysis requires the researcher to break down information into a manageable categories for analysis. Before engaging in the process of data analysis, the researcher prepared the data from semi-structured interviews, documents analysis, and non-participant observation into text form. The preparation started with the professional transcriber translating the data from audio to text. The researcher had three (3) data sets in the form of text from interviews, document analysis data, and observation data.

3.4.3.1 Interview data

Data from interviews were available in audio format and the professional transcriber translated it before analysis. The researcher read each transcript and jotted down notes to highlight important aspects. Again, the researcher listened to audios from the transcriber to verify their true reflection. This highlighted important codes even before the data analysis commenced.

3.4.3.2 Data from documents analysis

This data was already available in text format and the researcher classified it according to schools. The researcher again verified the data with the help of a document analysis tool to check if all important information was available. Data from documents was typed into a word document in preparation for analysis.

3.4.3.3 Observation data

Data from observations was available in the form of text and the researcher authenticated it the against observation schedule. This data was transcribed into word format before further analysis.

The data was arranged according to the schools for each dataset, e.g., school 1 or school 2. Guided by Durcevic (2020), the researcher conducted two (2) phases of data analysis. During the first phase, the researcher used Atlas.ti to conduct the basic text analysis from the aforementioned sets of data. The second phase was conducted by interpreting outputs from the Atlas.ti such as tables, networks, word clouds, and word

lists. Three (3) projects were created on the Atlas.ti tool and they were named according to the source of data; for example, the first project was named interviews, the second one document analysis, and the third one observation. Documents were uploaded chronologically according to the pseudonyms of schools 1, 2 and 3.

The researcher read each document again to identify codes. Open coding was used so that the researcher could control the wording of the codes on the system. Atlas.ti was used to create categories that were derived from the theoretical framework underpinning this study (see Section A of Chapter 2). This was done to ensure that the theoretical framework was still the lens that assisted the researcher to perceive, make sense of, and interpret the data. The categories were aligned with the aspects of the theoretical framework (explained in Chapter 4) to generate the themes that were used to present the data. The researcher used the codes, categories, and generated themes to create data analysis outputs such as tables, networks, word clouds and word lists. These outputs were used to present the data according to the generated themes that were aligned to the research questions in Section 1.3.1. of Chapter 1. This is the process that is discussed in Chapter 4.

The researcher later triangulated the data collected from interview data, documents data, and observation data and arranged it according to schools. Each school had a set of data from interviews, documents and observations from each educator.

3.5 MEASURES FOR TRUSTWORTHINESS

Trustworthiness is applied as a standard to judge quality and rigour in qualitative research. To this end, trustworthiness in scholarly research can be guaranteed through elements of credibility, transferability, dependability, and confirmability (Ibiamke & Ajekwe, 2017). In this study, the researcher ensured trustworthiness by incorporating the elements of credibility and dependability.

3.5.1 Credibility

Credibility in qualitative research is guaranteed when a study conducted (i) reflects the reality of the context within which it occurs; (ii) triangulates sources, methods, and theories; (iii) engages in persistent observation; (iv) maintains prolonged engagement with the respondents; (v) does member checking with the participants; (vi) seeks peer debriefing, and (vii) conducts negative case analysis.

(i) Reflection of reality

Credibility is ensured when the results reflects the reality within which the study is undertaken (Kivunja & Kuyini, 2017). For example, this study explored the role of play in teaching number sense to Grade 3 learners in South Africa. This study responded to the nationwide challenge of teaching Mathematics to learners in South Africa. Indeed, poor performance by learners in Science, Technology, Engineering and Mathematics (STEM) subjects, particularly in Mathematics, is a challenge in this country. As such, this exploration into the challenges of teaching Mathematics reflected the challenging reality of delivering STEM subjects in South Africa.

(ii) Methodological triangulation

The researcher combined methods of data collection such as semi-structured interviews, document analysis, and non-participant observation, this is called methodological triangulation (Heesen, Bright & Zucker, 2019). The researcher used methodological triangulation to address credibility as the researcher acknowledges that reality cannot be determined by a single truth. The researcher was also guided by Harrison et al. (2017) who stated that dependability of research results is verified through the scrutiny of others and by adhering to mechanisms that ensure rigour in data collection and analysis.

(iii) Observation

The researcher engaged in non-participant observation. She observed educators teaching number sense to Grade 3 learners through play. In the course of observation, the researcher saw and heard the educators and learners engaging in teaching and learning activities. The researcher was guided by studying the lesson plans of the educators while observing.

3.5.2 Dependability

The researcher recoded the data to validate her analysis (Matteson, 2020). During data analysis just after coding, the researcher waited for three (3) days to recode the same document again independently to compare consistency in the findings. The researcher followed Elliott's (2018) advice to do a qualitative comparison on which codes are most agreed on and present them as findings.

3.5.2.1 Internal validity

The researcher asked her supervisor for scholarly guidance to ensure the quality of internal data. Since the study used data instruments such as semi-structured interviews through recording, then data from the semi-structured interview were available in audio records that reduced internal bias. Furthermore, there were no negative cases from this to be reported. Lemon and Hayes (2020) advised that internal validity is shown when the truth is derived from the participants' lived experiences and in-depth understanding of that person's unique reality. In this study, the truth of the educators was interpreted and explored by observing how educators used play to teach number sense.

3.6 ETHICAL MEASURES

Fleming and Zegwaard (2018) stated that the researcher should consider the fundamentals of ethical research when involving human beings as participants. In this context, ethical approval should be granted before data collection.

3.6.1 Ethical Clearance Certificate

The researcher applied for research ethics clearance certificate with UNISA before data collection (Appendix B). The approval of research ethics was sent to LDoE through the district office (Capricorn South) to request a letter of permission to collect data in three (3) public primary schools of Limpopo (Appendix C). The permission letter from the LDoE was sent to three (3) principals and six (6) participating educators (Appendix E). The letter clearly stated the study area and the objectives of the research. This letter also informed participating educators about instruments used to collect data such as interviews, document analysis, and observation. All participating educators provided signatures on the letters of consent (see Appendix F).

3.6.2 Protection from Harm

Because of the Covid-19 pandemic, the researcher decided to conduct the interviews with the participants through online platforms such as Microsoft Teams. However, restrictions were lifted when the hard lockdown ended. The researcher was then able to conduct face-to-face interviews during the lessened restriction of the soft lockdown. Guided by the restrictions, the researcher maintained a social distance of 1.5 metres

between herself and the participants. Face masks were always worn and sanitisers were used to disinfect hands and objects such as tables.

3.6.3 Informed Consent

The researcher ensured that all participants were informed about the objectives and the process of the research by providing them with a detailed informed consent letter that explained the study (Appendix F). The potential participants were given appropriate time to read and understand the information sheet and to decide whether or not they want to be involved in this study. The participants asked the researcher questions regarding the study through phone calls and WhatsApp messages. The participants were requested to sign the consent letter that solicited their permission to partake in the study (see Appendix M). As such, their signatures were requested before data collection. The researcher further explained that participants had the right to withdraw from participating from the study at any time without providing reasons. Arifin (2018) agreed that the role of the researcher is to explain that participation is voluntary and refusing to partake or withdraw from the study will not affect them in any way. Moreover, Chimentão and Reis (2019) indicated that the researcher should be available for any clarification on any questions that participants might ask. Furthermore, the role of the researcher is to ensure that participants have the right to withdraw their consent without damage to themselves. Similarly, Fleming and Zegwaard (2018) explained that the role researcher is to fully inform participants of what will be asked from them, how the data will be used, and what (if any) consequences there could be. Since this study involved educators and learners as participants, the researcher ensured that parents signed consent forms (Appendix N) to consent to their children handing over their workbooks and classwork books to the researcher. Learners were asked to sign assent forms (Appendix O). Educators also provided their signatures for this. In this study, the researcher ensured that all participants were well informed, and anonymity and confidentiality were ensured.

3.6.4 Anonymity and Confidentiality

The researcher safeguarded anonymity and confidentiality of participants by not identifying any names or personal information during the reporting and analysis of data in this study. The researcher made an effort to ensure that all names of participants remained anonymous by replacing them with pseudonyms. Educators were requested

to remove their names and those of their schools from the lesson plans and from the learners' work as well, and replace them with pseudonyms before sending them to the researcher. Chimentão and Reis (2019) remarked that it is important to keep information of participants confidential and anonymous, assure that their names are protected, avoid using self-identifying statements, and use measures that help protect participants against unwanted exposure.

3.6.5 Data Protection

The researcher is obliged to preserve research records for a minimum of five years. Audio data from semi-structured interviews will be stored by the researcher in a computer with a password for five years. All data from lesson plans, copies of classwork books and workbooks will be scanned and stored in a computer with a password.

3.7 CHAPTER SUMMARY

This chapter explained the research methodology and research design used to explore the role of play in teaching number sense to Grade 3 learners. The researcher conducted her study in three (3) primary schools in the Limpopo Province. The researcher was guided by an interpretive case study design to collect qualitative data by conducting interviews, analysing documents and completing observations. The researcher used Atlas.ti to analyse collected data and adhered to all ethical issues as required by UNISA. The next chapter discusses the data analysis and interpretations of the findings in the study.

CHAPTER 4: DATA ANALYSIS AND INTERPRETATION

4.1 INTRODUCTION

The previous chapter described the research methodology. Interpretive case study design was selected to frame the planning and integration of the different components of this study coherently and logically, thereby, ensuring that the research questions are answered. As highlighted in Section 3.4.1 of Chapter 3, a purposive sampling strategy was used to select six (6) educators working in three (3) primary schools in the Capricorn South District of the Limpopo Province. This study explored the role of play in teaching number sense to Grade 3 learners. The researcher used individual semi-structured interviews to solicit the views and perceptions of Grade 3 educators when using play to teach number sense. Document analysis was used to gather data that assisted in corroborating the views and perceptions of the Grade 3 educators. The researcher collected data by conducting classroom observations where she observed how Grade 3 educators used play to teach number sense.

In this chapter, the researcher explains how she prepared the data for analysis, presented the data as per each data collection tool, and discussed the findings according to emerging themes that were aligned to the components of the theoretical framework thus strengthening this study. In Chapter 2, the theoretical framework was discussed in detail in Section 2.2.1 entitled “Vygotsky’s social development theory” and in Section 2.3 under the heading “Gardner’s theory of multiple intelligences”. This study asked the following questions:

1. What role does play perform in teaching number sense to Grade 3 learners?
2. How can play be used to teach number sense to Grade 3 learners?
3. What types of play can help to teach number sense to Grade 3 learners?
4. What guidelines do educators follow when integrating play in the teaching of number sense?

4.1.1 Description of Participants

Six (6) educators who participated in this study were from three (3) public primary schools in the Lebopo Circuit under the Capricorn South District, which means from each school, two participants were selected. Section 3.6 in Chapter 3 emphasised that it is important to safeguard the anonymity and confidentiality of the research

participants. Educators who participated in this study were given pseudonyms to protect their identities. Three (3) public primary schools were named and ranked according to the chronological order of visit, namely, School (S) 1, 2 and 3. The same chronological ranking was done for the educator's names as follows: School 1 Educator 1 (S1E1), School 1 Educator 2 (S1E2), School 2 Educator 3 (S2E3), School 2 Educator 4 (S2E4), School 3 Educator 5 (S3E5) and lastly, School 3 Educator 6 (S3E6). Pseudonyms given to educators are used in the presentation of data later in this chapter. All the educators were qualified and professionally experienced to teach Mathematics in Grade 3. Table 4.1 presents the biographical details of the participants.

Table 4.1: Biographical data of research participants

SCHOOL AND ITS PARTICIPANT	PARTICIPANT GENDER	WORK EXPERIENCE	QUALIFICATIONS
S1E1	Female	Ten (10) years	B.Ed. honours
S1E2	Female	Five (5) years	NPDE in the Foundation Phase
S2E3	Female	Four (4) years	BA degree
S2E4	Female	Sixteen (16) years	B.Ed.
S3E5	Female	Three (3) years	B.Ed. Honours in Natural Science
S3E6	Female	Thirty-six (36) years	ACE in Mathematics

4.1.2 Geographical Details of the Research Site (Lebopo Circuit, Capricorn South District)

All three (3) public primary schools were located in Lebopo Circuit in the Capricorn South District and their urban centre was Polokwane City, which is the capital of the Limpopo Province. All government schools in the Lebopo Circuit fall within the Quintile 2 designation of the DBE (i.e. they are no-fee paying schools because they fall into a socioeconomic category that is classified as 'poor'). Interestingly, this circuit was named after its rolling mountains called Lebopo. It is located at Ga-Molepo village, which is 53.7 kilometres from Polokwane. Ga-Molepo is divided into several villages that are led by Chief Molepo, they still live according to their culture and ancient belief. The schools are in close geographical proximity to each other, which is why the

researcher selected them. S1 was located 2.9 kilometres from the researcher's home, while S2 was 8.1 kilometres away, and S3 was 36 kilometres away. Figure 4.1 illustrates the distance between the three (3) public primary schools.

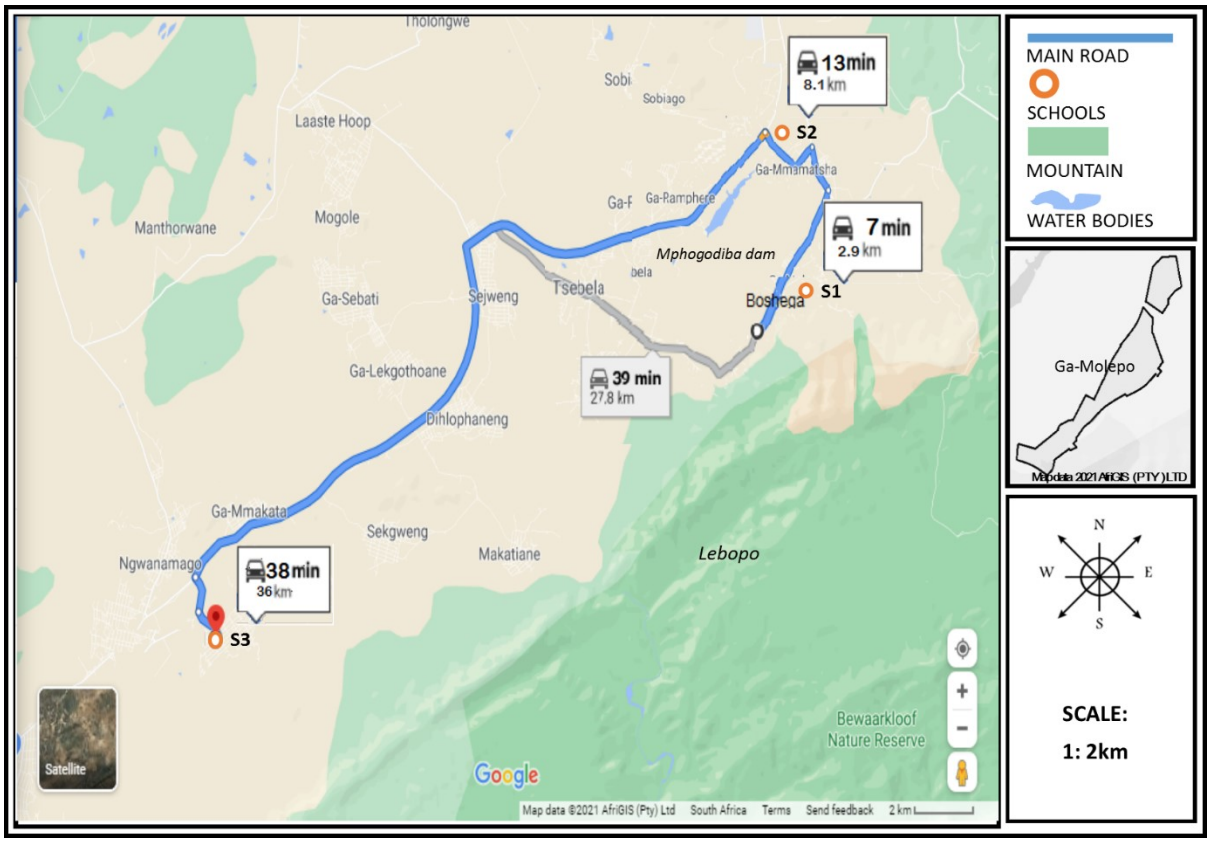


Figure 4.1: Research site of three public primary schools.

Source: Mapdata (2021)

As shown in Figure 4.1, the schools are relatively close to one another. The schools were selected because they had a similar socioeconomic background with a high rate of unemployment in their surrounding communities (Statistics South Africa, 2018). Learners from these villages experience a lack of clean water and electricity, and most of them stay with their illiterate grandparents. In turn, these grandparents support their families through the monthly social security grants they received from the South African Social Security Agency (SASSA). These families supplement their livelihoods through subsistence farming, although rainfall is infrequent due to climate change. The schools receive Learning and Teaching Support Materials (LTSM) to support play in teaching and learning number sense.

4.1.3 Preparation of Data

Abdallah, Du and Webb (2017) defined data preparation as a process of preparing raw data for analysis that helps with validation. It is stated in Section 3.4.2 of Chapter 3, the data was collected by using semi-structured interviews, document analysis and non-participant observation. In this section, the researcher outlines how each data set was prepared for analysis.

4.1.3.1 Interviews

During the interview sessions, the researcher used an audio recorder to capture the conversations between the investigator and participants. The audio data was saved in different folders labelled according to each participant which were sent to a professional transcriber. After transcription of data, the researcher listened to the recording again while reading through the transcription to check for any mistakes and omissions. The transcribed data was also sent to the supervisor who used the research question and interview questions to verify the data's accuracy and integrity. A sample transcript is attached as Appendix P.

4.1.3.2 Document analysis

Upon receiving ethical clearance from UNISA and permission from the Capricorn South District Office, with the principal's permission, the researcher requested the educators' lesson plans, and the learners' classwork and workbooks to extract data that showed the use of play in the teaching of number sense. The researcher used the document analysis schedule (Appendix J) that she created when preparing for the data collection process. The data collected from the documents was saved for each school in different electronic folders.

4.1.3.3 Observations

The researcher, as a non-participant, observed the teaching and learning activities in six (6) Grade 3 classrooms to gather data on how educators used play to teach number sense, as well as to identify the role of play in the teaching and learning of number sense. The researcher recorded what she observed on the observation schedule (Appendix K). The researcher observed teaching and learning activities inside and

outside the classrooms without participating and viewed the types of play that educators used to teach number sense.

4.2 DATA ANALYSIS

Interviews, document analysis, and observation data were prepared into text format in a word document. As indicated in the introduction of this chapter, Atlas.ti was used to code all data sets. The researcher started by coding data manually and later converted data into pdf format and imported it into Atlas.ti and coded it electronically. The codes were created from the keywords in the interview questions that were related to some of the keywords in the research questions. The researcher's supervisor co-coded the data, and the researcher compared the codes. Seven (7) codes created are summarised in Table 4.2.

Table 4.2: Summary of codes

	Data from document analysis	Interview data	Observation data	Totals
Importance of number sense	0	6	0	6
Integration of play activities and assessment activities	4	0	0	4
Number sense	7	20	6	33
Play	45	54	37	136
Role of play	11	27	14	52
Types of play	6	4	5	15
Use of play	11	22	10	43
Totals	**84**	**133**	**72**	**289**

Table 4.2 indicates the identified number of codes per document analysis data, interview data and observation data.

Column 2 to 4 of Table 4.2 illustrate the number of codes per each data set when the text was analysed through using Atlas-ti. Column 5 (the last column) illustrates the total number of codes that was coded in all data sets. The highest code was "play" (136) followed by "role of play" (52). "Integration of play activities and assessment activities" (4) that was coded in data from document analysis was not found in the interview data and observation data. "Integration of play activities and assessment activities" recorded the lowest number of instances which is an indication that

educators experienced difficulties in integrating play activities with assessment activities.

Multiple coding increases validity and consistency of data, as a result. The researcher first coded and recoded the data and her supervisor co-coded the data to ensure quality. Linneberg and Korsgaard (2019) stressed the importance of assessing the validity of text data coding. In this study, the validity of coding text data was ensured by two researchers. From Table 4.2, column 5 represents the total number of each code. This column serves as an indication that all the codes were prevalent in the data. Although the "Integration of play activities and assessment activities" was not mentioned during interviews and observation data, it still added to a total of 4 in column 5. In Table 4.3, the researcher linked the research questions and the components of the theoretical framework to create categories for the codes.

Table 4.3: The link between the components of the theoretical framework and research questions

Research questions	**Theoretical framework**
What role does play perform in teaching number sense to Grade 3 learners?	The relationship between play and social interaction in the teaching of Mathematics.
How can play be used to teach number sense to Grade 3 learners? What guidelines do educators follow when integrating play in the teaching of number sense?	The role of the educator as MKO when using play in the Mathematics classroom.
What types of play can help to teach number sense to Grade 3 learners?	Logical-mathematical intelligence.

Grant and Osanloo (2014) posited that the research questions act as a link between the theoretical framework components in a study and the problem the researcher wants to resolve. Table 4.3 illustrates that the first question asked: W*hat role does play perform in teaching number sense to Grade 3 learners*? links with the relationship between play and social interaction in Mathematics teaching. The second question: *How can play be used to teach number sense to Grade 3 learners*? and the fourth question: *What guidelines do educators follow when integrating play in the teaching of number sense?* address the educator's role as MKO when using play in the Mathematics classroom in teaching number sense. The last question of the interviews:

What types of play can help to teach number sense to Grade 3 learners? linked to the logical-mathematical intelligence of this study regarding the different types of play that can enhance the logical-mathematical intelligence to increase socialisation in the classroom. The above exercise of linking the research questions and theoretical framework was aimed at identifying categories in line with the codes, as indicated in Table 4.4

Table 4.4: Categories and codes

Category	Code(s)
The role of the educator	• Importance of number sense • Integration of play activities and assessment activities • Role of play
The relationship between play and social interaction	• Integration of play activities and assessment activities • Role of play • Use of play
Logical-mathematical intelligence	• Integration of play activities and assessment activities • Number sense • Role of play • Types of play • Use of play

The categories presented in Table 4.4 were formulated by selecting components of the theoretical framework that the researcher found to be linked with the codes. Table 4.4 illustrates the link between the categories and the codes.

In the next section, the researcher presents the findings of this study, starting with educators' views from the data collected through the interviews. Educators' views are validated (as advised by Kawulich, 2005) with the researcher's interpretations and descriptions made during the classroom observations. Validation of the educators' views was done to ensure the reliability of the findings (Bawani, 2020). Lastly, the researcher triangulates the views from the interviews with the interpretations and descriptions from the observation by presenting the confluence of evidence from the document analysis (Bowen, 2009).

4.3 PRESENTATION OF FINDINGS

The researcher presents the findings of this study according to the data generated from the interviews, document analysis, and observations. The researcher solicited educators' views during interviews while the observations ensured that the researcher validated the educators' views through her interpretations and descriptions of what was experienced in the classrooms. The researcher added the findings from the document analysis to corroborate the views and the interpretations.

4.3.1 The Use of Play When Teaching Number Sense.

The first question asked to the educators was about their views on the use of play when teaching number sense. Figure 4.2 presents the quotations generated through Atlas.ti.

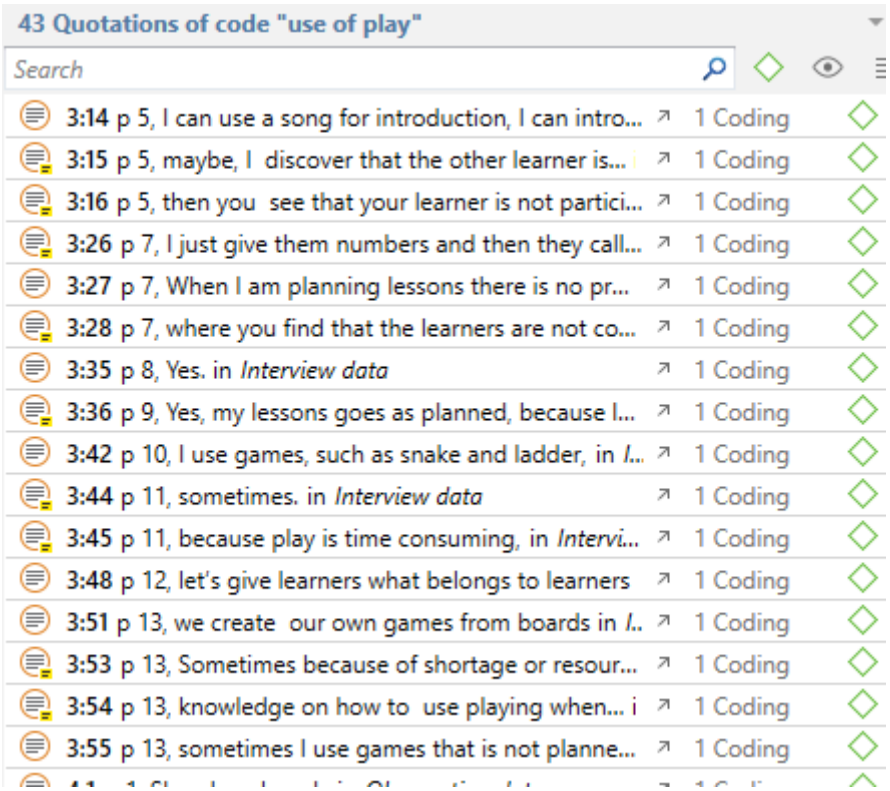


Figure 4.2: Educators quotations on the use of play

Figure 4.2 shows that 43 quotations were generated from three (3) data sources (interviews, observations, and document analysis). The educators expressed different views where three (3) of them viewed play as an essential tool for the teaching of number sense. All five (5) educators gave different reasons for their views. S1E1 said:

"*I find it very useful because it is learner-centred."*

S1E2 explained that play encourages the learners to participate fully in the teaching and learning activities. With a different view was S3E6, who felt that it was all about what learners need. She said:

> "*My views are let us give learners what belongs to learners. The learners' work is play, I think playing and teaching number sense for Mathematics as a whole in Foundation Phase are like twins. You can never separate them when teaching and learning activities.*" (S3E6)

The third question was more of a follow-up to the first one because the researcher wanted to explore how educators use play when teaching number sense. The educators explained the different ways they used play when teaching number sense. The ways, among others, included indoor and outdoor games. S3E5 mentioned that her preference was for outdoor games, especially now due to the Covid-19 pandemic. She elaborated that with the outdoor games, learners could have enough space to practise social distancing, which is one of the Covid-19 regulations for the South African national lockdown. She continued that:

> "*I use games, such as snakes and ladders, but it is now difficult because we have to adhere to Covid-19 regulations, and it needs a die and board with numbers, and it will help them in counting".* (S3E5)

One educator raised a concern about limited resources, which made their use of play difficult. When elaborating on the shortage of resources, S3E6 sounded very emotional and said:

> "*The schools in rural areas are disadvantaged because they do not have resources to participate in other play. Nevertheless, as creative educators, we create our games from boards. I always use outdoor games, for example, the game called "back-to-not", which helps learners in counting."* (S3E6)

However, educators mentioned the role of the educator when using play to teach number sense that is demonstrated in Figure 4.3 by using a network created through Atlas.ti networks

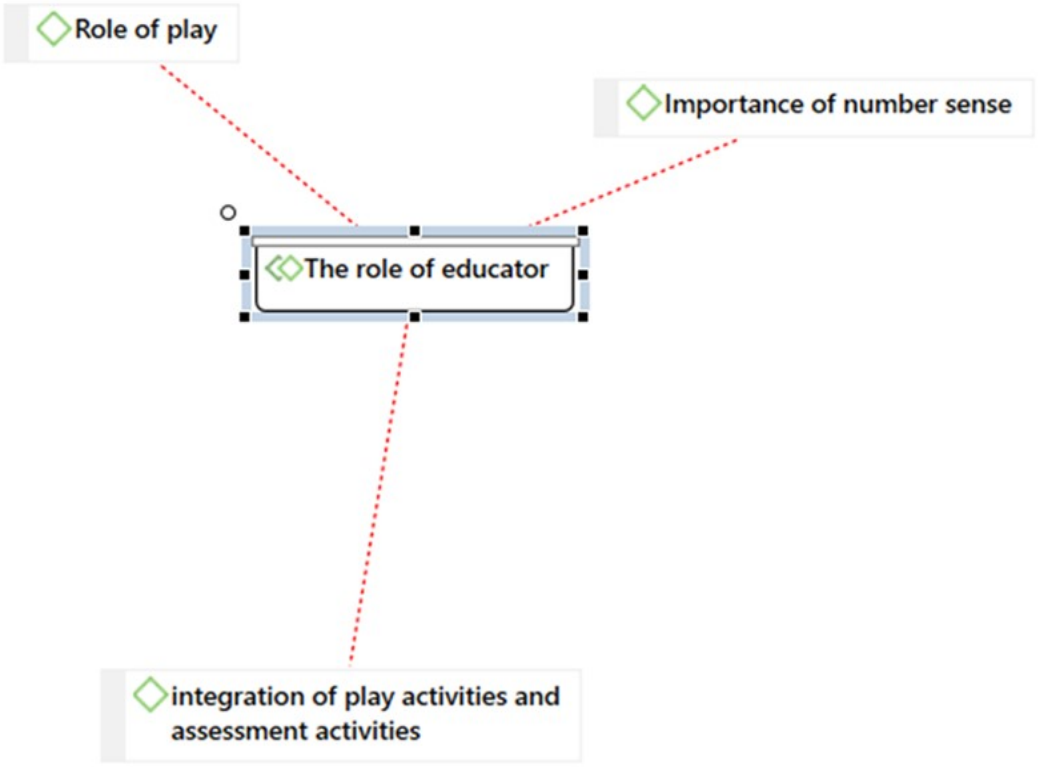


Figure 4.3. Network of the role of the educator when using play to teach number sense

As shown in Figure 4.3, the educator's role when using play to teach number sense includes the role of play, the importance of number sense, and integration of play activities and assessment activities.

The issue of a lack of resources was witnessed during the classroom observations. In Classroom 1, the researcher observed a shortage of printed resources because S1E1 did not have cards, so she created them from cardboard and painted them with water paints. The whole class was involved in playing cards during mental math and they were paired according to different learning abilities in a team of six (6) players. S1E3 gave learners cards that had the numbers 1 to 9 on them. The team kept their cards hidden and revealed them later. The educator asked each team to write numbers from their cards into their books and to round them off to the nearest 10th. The winner was the team that finished first. From six (6) players of each team, there was a scriber, team leader, and monitor who ensured that all players participated in the game.

What the researcher saw in classroom six (6), confirmed what S3E6 mentioned during the interviews. S3E6 used a game called '*back-to-nought'* to teach learners counting. The game was played by two (2) teams of four (4) players from each team. The resource used was a ball made from plastic bags. Learners started by drawing square shapes on the ground with smaller squares at each corner. Team 1 threw a ball to each other while Team 2 players ran to the spot in each small square while counting from 1 and avoiding being beaten by the opposite team's ball. If a player miscounted, they would start counting from zero. The winner would be the first learner to count to 30 without miscounting and being beaten by the ball. If the defenders tagged an attacker with the ball, that player was out.

4.3.2 Inclusion of Play in the Lesson Preparation.

The fourth question aimed to verify whether educators included play when planning their lessons. Five (5) educators answered that they did not include play in their lesson plans because they felt that it was something they could just add when they felt like it. This is what some participants had to say:

S1E1 said: "*When planning, no. I just involve it when I am busy teaching, maybe if I have a difficult word, learners will not understand, I switch to the play.*"

S1E2 also responded: "*Sometimes I do*".

The explanation from S2E3 showed that their lesson templates did not make provision for including play. Respondent S2E3 confirmed that: "*When I plan lessons, there is no provision for that, I don't use it.*"

The issue of limited resources was brought up again by S3E6 as a reason why she did not include play in the lesson plan. She mentioned that she only included playing sometimes because of the shortage of resources. It was comforting to hear a positive response from S1E4 who said that she included play when planning lessons.

The fifth question served to find out whether the educators adhered to their lesson plans when teaching. Three (3) educators (S1E1, S1E2 and S3E6) responded that they did not always follow their lesson plans while the other three (3) educators (S2E3, S2E4 and S3E5) said they always followed their lesson plans.

S1E1 replied… "*Because my learners usually are the ones who direct me, sometimes I may find myself to be out, or maybe slightly out of the lesson plan*."

S3E6 acknowledged this by saying: "*No, sometimes I use games that are not planned in the lesson plan to boost the concentration of learners*."

The educators' responses suggested that they used play as an intervention strategy when their lessons were not going well.

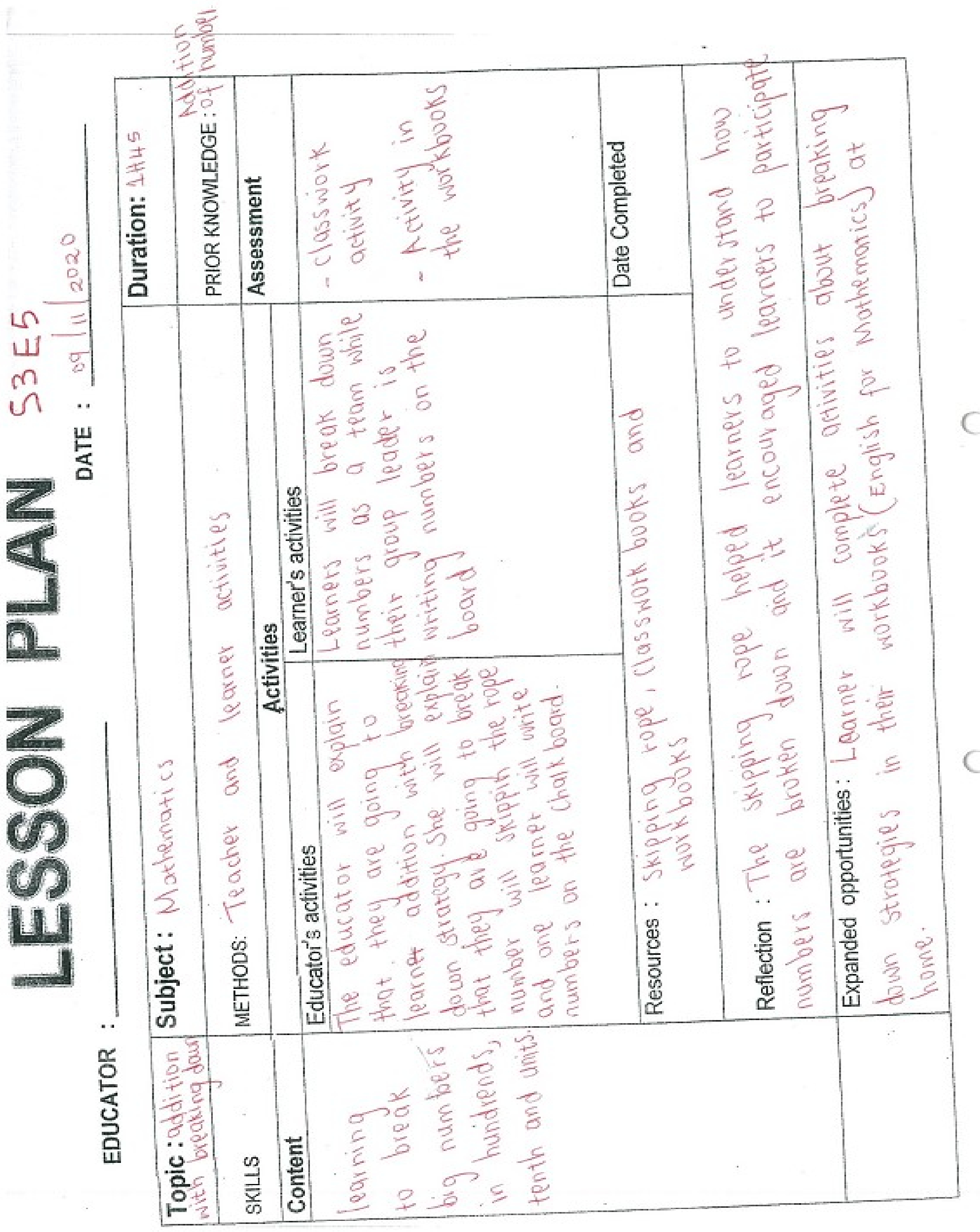
S1E2 confirmed this when she said:

> "*Remember if you are teaching, then you are active with your learners and then you see that your learner is not participating, they don't understand something, you sometimes go out and include some play or something to help learners*."

S3E5 said she included play in her lesson plans and attested to the positive results she gets. She said:

> "*My lessons go as planned because learners are always participating during the lessons because they are more interested in games*."

Figure 4.4 below outlines the lesson plan of S3E5 who incorporated play in her lesson.



LESSON PLAN S3E5

EDUCATOR :

DATE : 09/11/2020

Topic: addition with breaking down	Subject: Mathematics		Duration: 1H45
SKILLS	METHODS: Teacher and learner activities		PRIOR KNOWLEDGE: Addition of number
Content	Activities		Assessment
	Educator's activities	Learner's activities	
learning to break big numbers in hundreds, tenth and units.	The educator will explain that they are going to learn addition with breaking down strategy. She will explain that they are going to break number will skippin the rope and one learner will write numbers on the chalk board.	Learners will break down numbers as a team while their group leader is writing numbers on the board	- classwork activity - Activity in the workbooks
	Resources : skipping rope, classwork books and workbooks		Date Completed
	Reflection : The skipping rope helped learners to understand how numbers are broken down and it encouraged learners to participate		
	Expanded opportunities : Learner will complete activities about breaking down strategies in their workbooks (English for Mathematics) at home.		

Figure 4.4: Lesson plan of S3E5

During the classroom observations, the researcher noted that three (3) educators did not follow their planned lesson when teaching number sense. S1E1 and S2E2 did not

use play when planning the lesson but they switched to play when they found that learners had difficulties in understanding number patterns. The researcher further identified poor time management with the educators who do not incorporate play in their lesson but included it because of a lack of classroom participation.

From document analysis, the researcher found evidence of planned play activities from three (3) educators' (S2E4, S3E5 and S3E6) despite their responses during the interviews where five (5) of them said they did not include play in their lesson plans. Interestingly, S2E4's lesson plan outlined how the game was played and its aims and objectives. S3E6 also used it to assist learners to understand counting numbers. Figure 4.5 indicates the lesson plan of S2E4 with planned play with its aims and objectives.

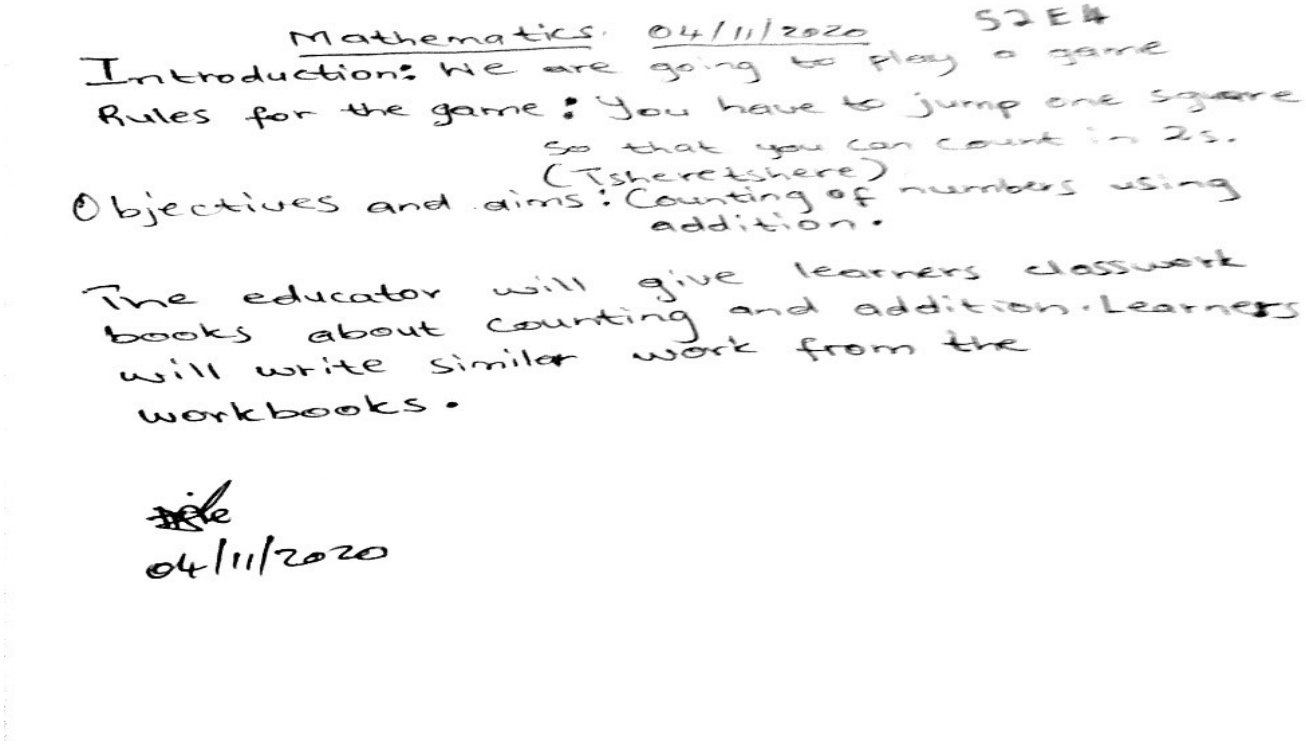

Mathematics 04/11/2020 S2E4
Introduction: We are going to play a game
Rules for the game: You have to jump one square so that you can count in 2s. (TshereTshere)
Objectives and aims: Counting of numbers using addition.
The educator will give learners classwork books about counting and addition. Learners will write similar work from the workbooks.
04/11/2020

Figure 4.5: Lesson plan of S2E4

4.3.3 The Role of Play When Teaching Number Sense.

Questions 2 and 8 explored the educators' views on the role of play. Question 8 focused on the purpose of play when teaching number sense. These questions are almost similar because, from the findings, four (4) educators explained that the role

and purpose of play in teaching number sense were to increase classroom participation. Figure 4.6 presents a sample of quotations that were generated on Atlas.ti on the role of play.

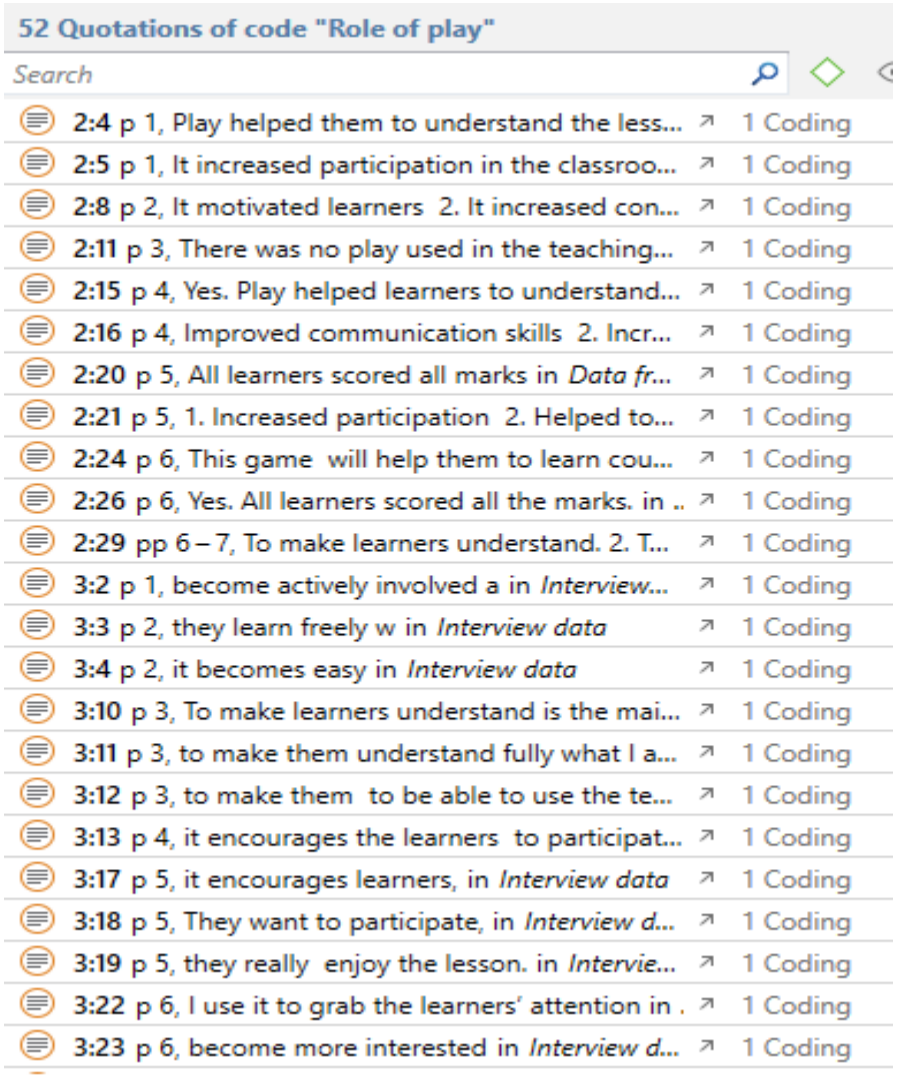


Figure 4.6: Educators quotations for the role of play

Atlas.ti generated 52 quotations from the interviews, observations, and document analysis. When responding to Question 2, these educators noted that play enhanced learners' participation in learning activities.

S2E3 confirmed this by saying: "*Play makes the learners so much active and interested in the lesson, every one of them will want to participate, even those that are slow.*"

Also, S3E5 agreed that: "*It helps to boost confidence. It encourages participation, it is a way of motivating learners.*"

The finding is consistent with S3E6 who said: "*It builds a relationship between learners and educator and among themselves. It increases participation in the lesson and motivates learners, especially weak learners or underperforming learners.*"

When responding to Question 8, educators reiterated that play has two purposes in teaching number sense. These are making learners understand numbers and improving classroom participation. S1E1 and S2E3 commented that play helped learners to understand numbers, with S2E3 saying:

> "*It makes learners understand numbers more. It makes all the learners interested in the numbers*."

S1E2, S2E4, S3E5 and S3E6 concurred that play encouraged learners to participate in the classroom.

S1E2 discussed that learners want to participate in play: "*They want to participate, they enjoy it, and they enjoy the lesson*. With a similar view, S3E5 stated: *"It helps learners to participate in the classroom, and also it builds self-confidence.*"

S3E6 also replied that: "*It increases participation."*

Educators' mentions of the purpose of play in teaching number sense is displayed in Figure 4.7 in the form of a word cloud created through Atlas.ti word cloud.

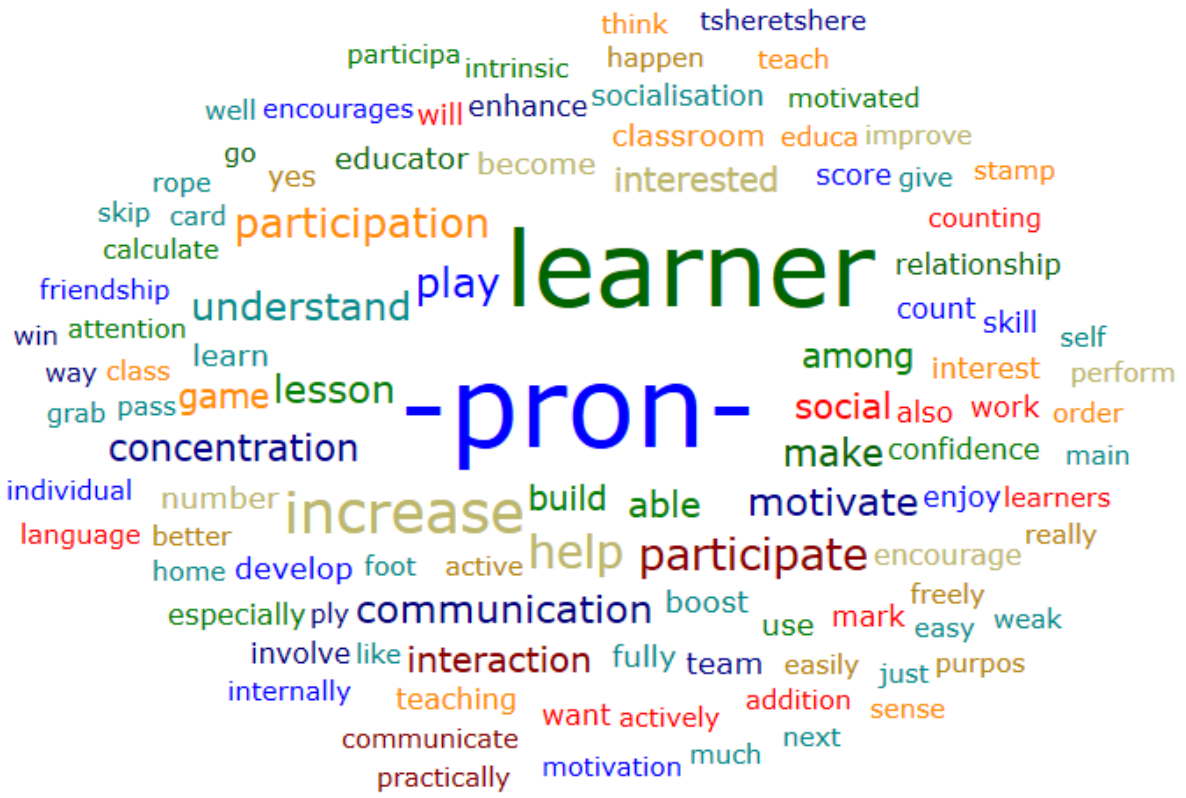


Figure 4.7: Word cloud illustrating the role of play

As illustrated in Figure 4.7, the role of play in teaching number sense included: participation, concentration, understand, socialisation, motivation, understand, confidence, encouragement, team, friendship, interest, and language.

During classroom observations, the researcher saw how the teaching and learning activities revealed the role of play, mainly when educators taught number sense topics. The researcher witnessed the social interaction that took place primarily when learners engaged in play. With regard to document analysis findings in the lesson plans, the researcher noted that five (5) out of six (6) educators included play when planning their lessons. The researcher uncovered evidence in the lesson plans of S3E5 who used play in the lesson presentation. The learners' classwork books contained activities that were related to the games the researcher observed in the classroom (Figure 4.8).

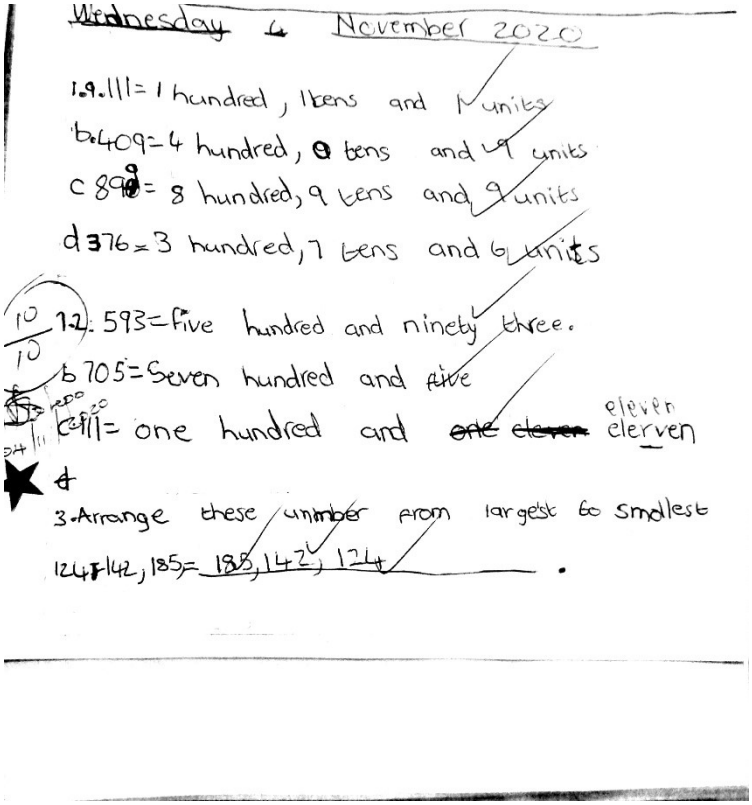


Figure 4.8: Learner's activity

The lesson taught in Classroom 5 by S3E5 included questions about the skipping rope game they were about to play. S3E5 explained to the learners that they were going to break numbers into hundreds, tens and units while skipping the rope. Players were two (2) underperforming learners and two (2) performing learners. Performing learners played the game well, while S3E5 helped underperforming learners to break the numbers down. The winners were the underperforming learners because the educator supported them. From all classroom observations, the researcher observed that play in teaching of number sense:

1) Increased communication between players.
2) Enhanced social interaction between the educator and learners.
3) Enhanced participation in the lesson.
4) Motivated learners.
5) Increased interest in learning number sense.

4.3.4 The Types of Play Suitable for Teaching Number Sense

Among all the codes used in the Atlas.ti, types of play generated the least number of quotations. Figure 4.9 illustrates the codes.

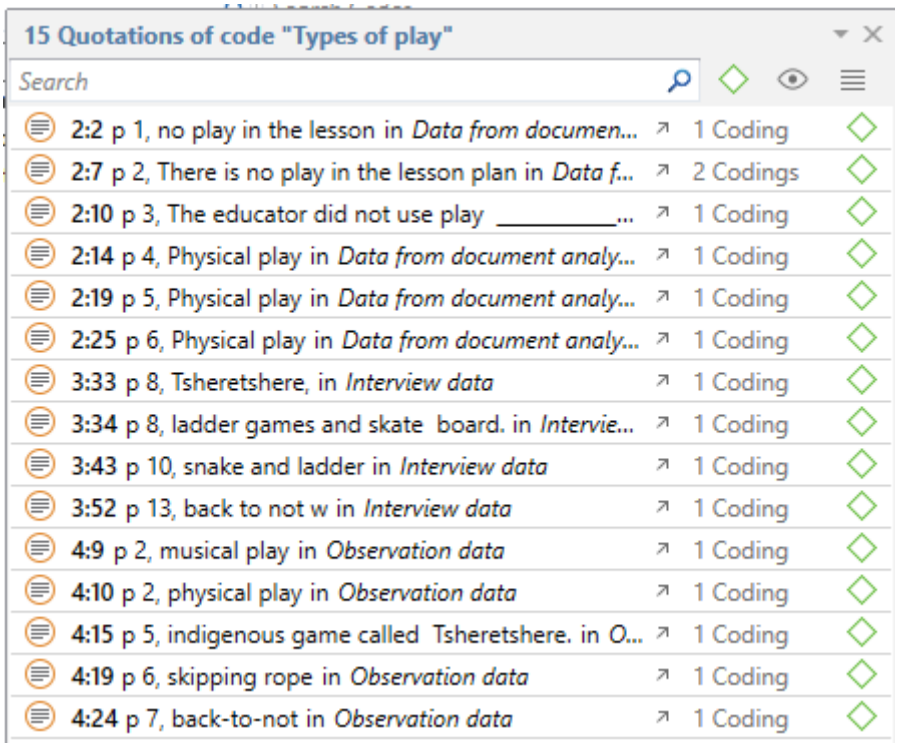


Figure 4.9: Educators' quotations on types of play

Types of play generated only 15 quotations from the Atlas.ti. This finding can be attributed to the educators' concern about the shortage of resources to engage in different plays. S3E5 explained that she experienced difficulties with the shortage of resources to engage learners in different types of play when teaching number sense; then, she always used outdoor games such as "do a number dance" and "hopscotch" that required no resources. She said:

> *"I always use games that are outdoor; for example, the game called "back-to-nought", which helps learners in counting. I always use 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 while learners stretch their arms forward, upward, downward, side by side. By doing that, also, I develop gross motor skills*." (S3E5).

S3E6 also mentioned that they did not have the resources to participate in other types of play. However, she created her games such as 'snakes and ladders' from cardboard.

"……the schools in rural areas are disadvantaged because they do not have resources to participate in other play; nevertheless, as creative educators, we create our games from boards." (S3E6).

Throughout the classroom observations, the researcher noticed that the educators' resorted to play that did not require resources, such as musical games. However, S2E4, S3E5 and S3E6 used physical play to teach number sense, while S2E4 added an indigenous game to her physical types of play called *Tsheretshere* to help learners count fast. S3E5 also used physical play where learners played a skipping rope game to breaking numbers down into hundreds, tens, and units. S3E6 used physical play where learners played an indigenous game called *back-to-nought* to count numbers. The researcher found that educators use physical play to teach number sense because it did not require resources, and it was integrated with Home Language and Life Skills subjects.

Document analysis showed that educators planned only physical play in their lessons because they lacked resources. The researcher noticed that a lack of resources meant that educators did not use different types of play in teaching number sense.

4.4 DISCUSSION OF FINDINGS

As indicated in Section 4.1 of this chapter**,** this study explored the role of play in teaching number sense to Grade 3 learners. This section presents the main findings through themes that emerged when the study's objectives were integrated with the theoretical framework. Table 4.5 summarises the relationship between the themes and the study objectives.

Table 4.5: The study objectives linked to the emerged themes

Objectives	**Emerging theme(s)**
• To explore the role of play in teaching number sense to Grade 3 learners	Theme 1: The role of play when teaching number sense.
• To establish how play can be used to teach number sense to Grade 3 learners • To recommend guidelines on the use of play when teaching number sense to Grade 3 learners	Theme 2. Integration of play when teaching number sense. Theme 3. The use of play to improve social interaction.

Objectives	Emerging theme(s)
• To identify types of play that can help to teach number sense to Grade 3 learners.	Theme 4. Types of play relating to logical-mathematical intelligence.

Table 4.5 illustrates that the four (4) themes that emerged from the data analysis were grouped according to their relationship to the objectives of this study. It should be noted that the themes were also linked to categories used to present the findings in the previous section. The first theme emerged from educators' views on the role of play when teaching number sense. Themes 2 and 3 emerged from the educators' views on the use of play when teaching number sense. Theme 4 emerged from the educators' views on the types of play suitable for teaching number sense.

4.4.1 Theme 1: The Role of Play When Teaching Number Sense.

In Section 1.1 of Chapter 1, it was noted that the DBE (2018) supported the need to use a play-based approach to teaching Mathematics. The same section explained that the DBE (2011a) stated that Grade 3 learners should exit the Foundation Phase with a high sense of numbers. The current study asked the question: "*What role does play perform in teaching number sense to Grade 3 learners*?" The literature found that social interaction was the primary outcome of play in the teaching of number sense. This statement is backed up by Daubet et al. (2018) who found that using play in teaching number sense leads to engagement and interaction in the classroom. The literature found that there is a strong relationship between play and teaching of number sense to Grade 3 learners.

This study found that an increase in play opportunities when teaching number sense also improved social interaction and enhanced learners' understanding of numbers. Other than interaction in the classroom, Rosli and Lin (2018) confirmed that play increases social interaction between educators and parents to ensure learners' safety in learning number sense. S1E1 elaborated that pupils can learn number sense through play practically at home with parents' guidance. This means that the relationship between play and socialisation can be strengthened by educators collaborating with parents to create a safe and secure environment for learning number sense through playing games at home.

This study revealed that most educators regarded the outcome of using play in teaching number sense as improved social interaction. Two (2) participants explained that learners with different intelligences may want to participate in play, but it also helped learners with mathematical barriers by facilitating their participation in play activities to develop number sense. Therefore, the researcher concludes that play encourages participation of learners with multiple intelligences and accommodates learning barriers in teaching number sense.

Most educators view the role of play in teaching number sense as improving learners' understanding of Mathematics. The above statement indicates that an increase in play opportunities also improves the learners' understanding of number sense. S2E3 said that the primary purpose of using play in the teaching of number sense is to make learners understand and learn at home by using the same games. This educator meant that play does not end in the classroom, but learners can play the same games at home to acquire more knowledge about number sense, thus increasing social interaction at school and home. The researcher notes that the role of play in teaching number sense is to make learners understand numbers and be able to exit the Foundation Phase with a solid number sense.

Different roles are anticipated by educators, such as an increasing concentration by learners, kindling their interest in the learning activities, encouraging working in teams and enhancing communication among educators and learners. This study acknowledges that number sense is enhanced through social interaction that is involved in play.

The relationship between play and social interaction was also evident from the researcher's classroom observation of the role of play in teaching number sense that encouraged teamwork. From all classroom observations, learners were able to work together as a team and as individuals. Learners were able to contribute to games when they were grouped according to teams.

What is interesting is that from classroom six (6), when learners were playing '*back-to-nought'* after the educator had paired learners into groups, learners selected their group leader because he could run fast and they then helped him to count. One learner said: "*wena ka gore o kgona go kitima ka lebelo otla tsena rena re tla go thuša go bala dinomoro" (because you can run fast, you can represent us and we will help you to*

count numbers). Communication between learners, decision-making skills and teamwork were evident. Moreover, the learners were motivated by the group leader's running skills and play was fun. Drawing from these findings, the researcher notes that the role of play is realised through social interaction.

From Classroom 1, when learners were playing cards during mental math, learners could communicate as a team and make decisions together. The game was interesting to learners because they already knew how to convert numbers to the nearest tenth from previous school terms. Learners were excited, eager to win, and they were all participating, which made them understand how to convert numbers to the nearest 10th. Figure 4.10 below is an extract from a learner's workbook that indicate that the learner scored full marks because play helped them understand.

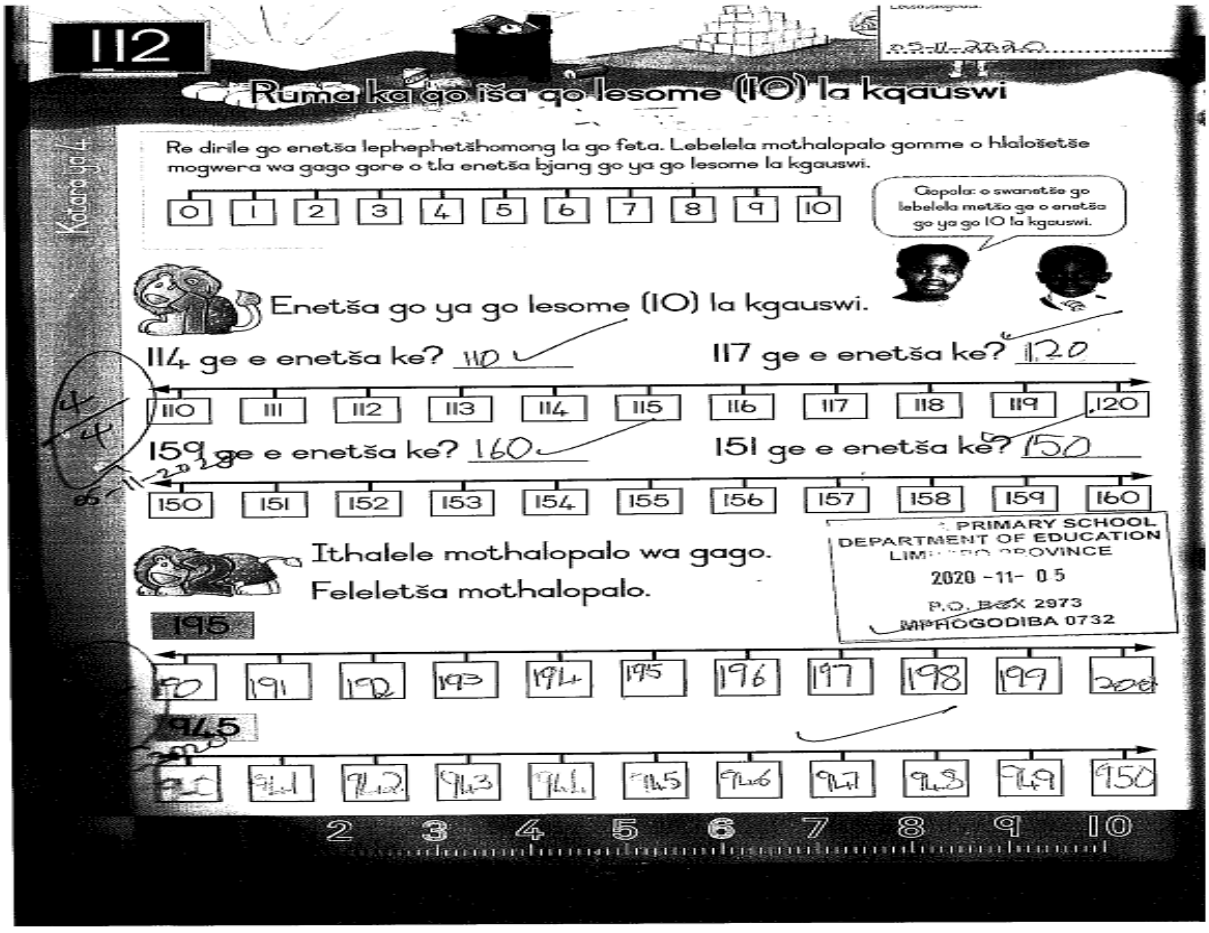


Figure 4.10: Learner's workbook from Classroom 1

The role of play was evident from Classroom 5 when learners were playing '*skipping rope'*. While skipping, learners needed to break a number into hundreds, tens and

units. Learners were helping each other as team members to win the game. The communication and participation throughout the game between learners helped them to understand how to break down numbers.

The relationship between play and socialisation in the teaching of number sense can be strengthened by the collaboration of parents and educators to create a safe and secure play setting, which helps learners participate in play to develop number sense.

4.4.2 Theme 2: Integration of Play When Teaching Number Sense

This study asked: *What guidelines do educators follow when integrating play in the teaching of number sense?* In the literature, Fu (2010) stated that an educator's role is to effectively integrate play when teaching number sense to Grade 3 learners to enhance social interaction. Against this background, the researcher notes that an educator's role is to integrate play and plan lessons to enhance social interaction in the teaching of number sense.

Educators use lesson plans when teaching number sense in the classroom. Since the study found that play makes learners understand, it is the educator's responsibility to integrate play into the lesson plan. There should be guidelines that educators follow when integrating play and learning activities. However, the findings showed that educators used play as an intervention strategy because they lacked knowledge of how to integrate it when teaching number sense, and there were no guidelines that helped educators in this regard. The researcher observed that educators could use play when planning their lessons, but they did not apply their skills in its preparation. It was further revealed that educators do not always follow their lesson plans. Five (5) educators did not follow a lesson plan because they did not plan play lessons, yet they used it as an invention strategy to get learners engaged and to make them understand number sense. This study suggests that educators should have guidelines on integrating play in the teaching and learning of number sense. These guidelines would help educators in the integration of play during planning, introduction, presentation, and assessment of lessons when teaching number sense.

4.4.3 Theme 3: The Use of Play to Improve Social Interaction

A strong relationship between play and social interaction has been reported in the Chapter 2, Section 2.4.2. The researcher found that educators from different regions

including European and African countries including South Africa used play to improve social interaction. As such, this study asked: *how can play be used to teach number sense to Grade 3 learners?* When looking at the literature of this study in Chapter 2, Section 2.2.2, it was found that it is the responsibility of MKO is to improve social interaction by using play in teaching and learning activities (Wium & Louw, 2012). The researcher also drew from Dele-Ajayi et al. (2019), who used the game *Speedy Rocket* to motivate learners, enhance enthusiasm, excite them, and increase communication as they interacted with one another.

An educator needs to understand their role of using play in the teaching of number sense either in planning or presentation of lessons. Some educators who participated in this study planned and facilitated play in teaching activities. S2E4 planned her lesson and explained how the game was played, the rules of the game, and the objectives that she wanted to achieve from the game. She helped learners to play the game and to facilitate it to improve social interaction.

One of the other reasons for using play to improve social interaction is because play is learner-centred. Play focuses more on learners rather than educators. The educator's role in these activities is to facilitate play when teaching number sense to enhance social interaction. As one of the educators said "to play is helpful" because it is learner-centred which is encouraged by the South African curriculum. The findings further suggested that play helps learners to socialise with one another in the classroom. It also allows learners to make their own decisions and develop communication skills.

From document analysis, it is clear that educators were neglecting their role in using play when planning their lessons. That led to adverse outcomes because learners did not understand what was expected from them. For example, S2E3 did not use play in planning and teaching number sense. This resulted in learners not understanding and most learners did not get full marks. The snapshot below in figure 4.11 shows the learner's classwork task from S2E3.

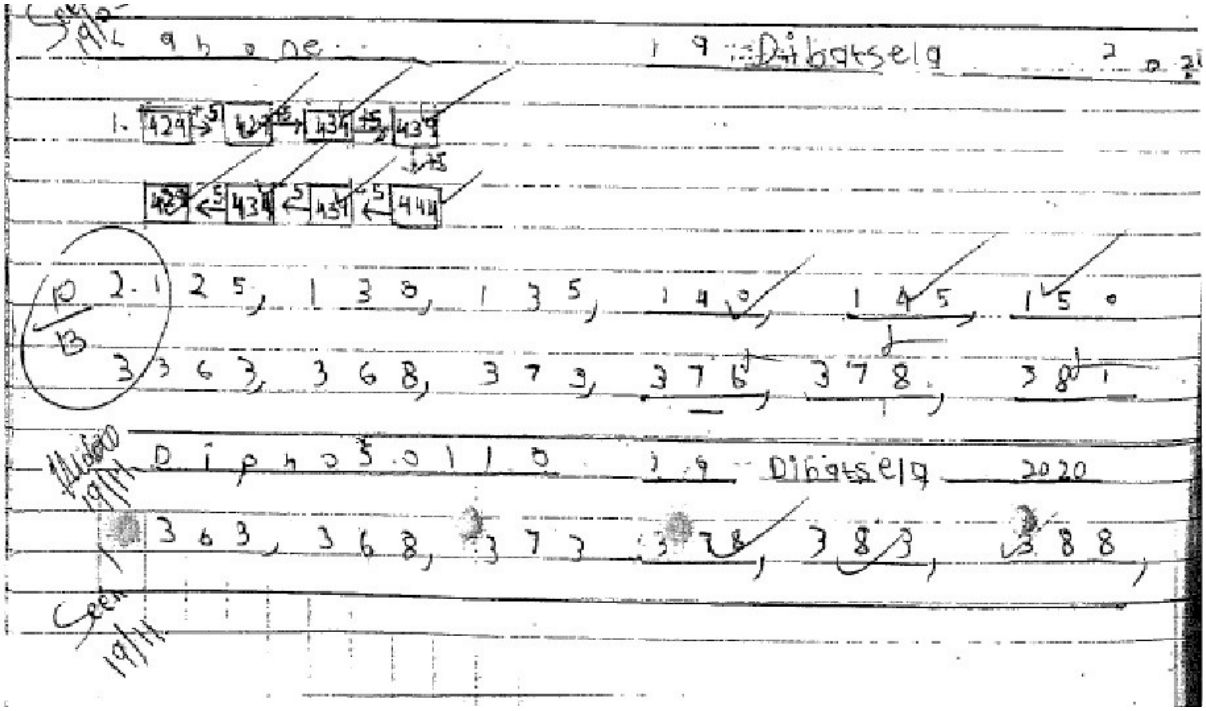


Figure 4.11 Snapshot of learner's classwork from S2E3

A learner can act as an MKO in play activities in teaching and learning activities. For example, in Classroom 2, learners were able to communicate freely in musical play. Talking about this social interaction issue, one learner from Classroom 2 said: "*aowa re betha diatla le matsong ka nako e tee gomme ra bitsa nomoro*" (We clap our hands at the same time while calling out a number). The findings from the observations show that play increases communication opportunities among learners and the educator. There was participation from all learners. In Classroom 2, S1E2 called one learner to the front to write on the board the numbers the other learners called and this motivated the learner. When one learner from Classroom 2 struggled with the rhythm of singing and stamping the feet, the other learners helped him, which increased communication among learners. In Classrooms 4 and 6, the researcher observed that play was used to encourage teamwork in the learning of number sense.

This study's findings also show that the role of an educator who acts as an MKO is to improve social interaction by using different types of play when teaching number sense.

4.4.4 Theme 4: Types of Play Relating to Logical-Mathematical Intelligence

Section 2.5 of Chapter 2 reported on the types of play that can be used to teach number sense. The researcher discussed some of the types of play from Dicker and Naude (2019) that can be used to teach number sense. The literature indicated that logical-mathematical intelligence can be expanded by engaging in real-world activities like play that is executed in the real world (Rosli & Lin, 2018). The researcher agreed with Gordon and Browne (2011) and Woolfolk (2014) that it is the role of an educator to expand logical-mathematical intelligence by using different types of play to teach number sense.

Participants used different types of play to expand number sense. Most participants used musical play to introduce lessons when teaching number sense in the classroom. Some educators planned physical play in their lessons to include examples such as wordplay using flashcards. These results indicated that outdoor play was the type that was most used. Respondent S3E6 and Omidire et al. (2018) had a similar view that physical play can benefit learners' development. Respondent S3E6 said that physical play is used to teach Mathematics and develop gross motor skills.

The researcher identified the following types of games that the educators used to expand the intelligence of numbers such as playing cards, singing songs, *Tsheretshere*, *Skipping rope*, and *back-to-nought*. These games fall under different types of play but are mostly physical play. *Tsheretshere*, *skipping rope*, and *back-to-nought* are locomotor play, while cards are wordplay, and songs are musical play. All these types of play used by educators are relevant in improving logical-mathematical intelligence because they help learners compare numbers, count forward and backwards, and understand number patterns.

Therefore, this study's findings show that different types of play in teaching number sense can be used to improve social interaction in the classroom. All types of play are important in a Grade 3 learner as each type has a role in the teaching and learning of number sense. For example, wordplay develops communication skills, and physical play is integrated with Life Skills. These findings show that play is integrated with a Home Language, Mathematics, and Life Skills because as it also develops gross and fine motor skills.

4.8 CHAPTER SUMMARY

This chapter presented a narrative analysis and interpretation of qualitative data collected through semi-structured interviews, document analysis, and classroom observation. Furthermore, the chapter discussed the preparation of data, and the presentation and discussion of findings through themes that emerged. In the next chapter, the merged narrative analysis was used to draw the summary, conclusions, and recommendations. The results from the merged findings assisted in drawing conclusions that are presented in Chapter 5.

CHAPTER 5: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

This chapter integrates all the chapters of this study summarise the research, draw conclusions and make recommendations. The summary underlines critical points in the findings. Yusuf (2018) mentioned that conclusions are important as they provide opportunities for a reader to understand the summary of each chapter and the research problem of the study. This then leads to recommendations that address the research problem. In this chapter, the researcher summarises the findings to enlighten educators about the use of play in teaching number sense to Grade 3 learners to improve social interaction.

Chapter 1 to 4 have been incorporated with the aim: *Exploring the role of play in teaching number sense to Grade 3 learners* and the central question as framed in Section 1.3.1 of Chapter 1: *What role does play perform in teaching number sense to Grade 3 learners*? To connect the aim in Section 1.3.2 and the role of play in teaching number sense, four sub-questions in Section 1.3.1 of Chapter 1 needed to be answered. Later, the researcher acknowledges the limitations and the guidelines of the study and offers recommendations.

5.2 SUMMARY OF THE THEORETICAL FRAMEWORK AND LITERATURE REVIEW

This section summarises Chapter 2 of this study which focused on the theoretical framework and literature review because they provided an essential basis for data analysis and the recommendations made in this chapter.

The role of reviewing the literature for this study was to integrate what other researchers found about the role of play in teaching number sense to Grade 3 learners. The discussion was also motivated by two theories, namely, Vygotsky's social development theory and Gardner's theory of multiple intelligences which formed the theoretical framework that underpinned this study.

5.2.1 Summary of the Theoretical Framework

The theoretical framework formed the first part of Chapter 2, and it focused on the two theories: Vygotsky's social development theory and Gardner's theory of multiple

intelligence. The application of the theoretical framework as outlined in Section 2.2 described the influence of these two theories on the main aim of this study: *Exploring the role of play in teaching number sense to Grade 3 learners* in Chapter 1 (Section 1.3.2).

In the discussion of the two theories, it was found that both theories related to the role of play in teaching number sense to Grade 3 learners (Section 2.2.1-2.3.1). The role of the educators (specifically MKO) when using play in teaching Mathematics in Vygotsky's social development theory was put forward by studies conducted by Fu (2010), Özdogan (2011) and Moomaw (2011) outlined in Section 2.2.2. In Section 2.2.3, the relationship between play and social interaction in the teaching of number sense was highlighted by Rosli and Lin (2018) who noted that socialisation during play can be strengthened by the collaboration of stakeholders (parents). The role of Gardner's theory of multiple intelligences (especially logical-mathematical intelligence) in Section 2.3.1 was highlighted in studies by Gordon and Browne (2011) and Woolfolk (2014). Their view was that it is the responsibility of the educator to use different types of play to expand logical-mathematical intelligence through play which increases social interaction.

A significant conclusion was that both Vygotsky's social development theory and Gardner's theory of multiple intelligences promote social interaction during play. This links to the primary aim of this study (Section 1.3.2). Common to both theories was the emphasis on social interaction, which plays a vital role in the use of play in teaching number sense to Grade 3 learners. Figure 2.2 summarises the relationship between the two theories that interconnect the social interaction through the role of the MKO in enhancing logical-mathematical intelligence through the use of play in teaching number sense to Grade 3 learners. Social interaction is stimulated when an educator is expanding logical-mathematical intelligence during teaching and learning Mathematics. When learners are engaged in the activity and participate by asking and answering questions, social interaction flourishes.

Generally, the literature review (Chapter 2) provided insight for this study regarding the role, use and types of play in teaching number sense. The theoretical framework also emphasised the significance of social interaction/socialisation when using play to

teach number sense to Grade 3 learners. What follows is the summary of the literature review in the last part of Chapter 2.

5.2.2 Summary of the Literature Review

The role of play in teaching number sense was evidenced by scholars such as Sharma (2017) and Dicker and Naude (2019) who found that the main role of play in teaching number sense to Grade 3 learners is socialisation (Section 2.4.1). Play is linked with Vygotsky's social development theory and Gardner's theory of multiple intelligences because educators need to use play to improve logical-mathematical intelligence. There is a significant relationship between the role of play and the use of play in teaching Mathematics because the role of play is more evident when educators use play to teach number sense.

The use of play in teaching number sense was discussed in Section 2.4.2 based on empirical studies which were conducted in the past three years in five countries Sweden, Switzerland, Nigeria, Kenya and South Africa (Western Cape and Gauteng).

The study conducted in Sweden found it crucial for educators to be involved in play to strengthen socialisation when guiding play (Björklund et al., 2018). The study linked the role of MKO to Vygotsky's social development theory because educators play a vital role when guiding play. The study on Switzerland by Vogt et al. (2018) explored the use of card and board games to motivate children's learning and increase interest. In using such games, they are enhancing logical-mathematical intelligence of learners.

The study on Nigeria by Dele-Ajayi et al. (2019) focused on how the Speedy Rocket game improved socialisation. The researchers shared tips about learning mathematical concepts from the game which reconciled with the relationship between play and socialisation in the theoretical framework. The study of Tsindoli et al. (2018) from Kenya showed that culture can be used to increase social interaction. Tsindoli et al. (2018) used an indigenous game called *Kora* to teach number sense. They indicated that the role of the educator as the MKO is to give guidance when using indigenous play.

In South Africa, one of the studies that took place was on the Western Cape which indicated the use of resources to increase socialisation during exploratory play (Mntunjani et al., 2018:8). The study showed that there is a relationship between the

use of mathematical resources and socialisation. The study on Gauteng by Omidire et al; (2018:4) showed that the use of bean bag toss games increased socialisation which also increased learners' teamwork, group participation and social skills. The use of the bean bag toss game supports the relationship between play and socialisation in the teaching of Mathematics.

The literature review ended with a discussion of types of play that can be used to teach number sense. The discussion in Section 2.4.3 was based on physical play, construction, exploratory play, creative play and wordplay. These types of play can be played in both indoor and outdoor settings. Physical play was discussed by Bose and Seetso (2016) showing that there is a relationship between physical play and socialisation. Physical play includes indigenous games which does not require cost resources as the school from rural areas lack these resources (Bose & Seetso, 2016). They can also benefit in children's development (Omidire et al.; 2018; Section 2.4.3).

There is a relationship between the role of MKO and construction play. Mntunjani et al. (2018) stated that the role of MKO is to give direction in construction play which increases socialisation. When learners construct with blocks, they interact with one another and communicate. Construction can be used indoors during a lesson. From the discussion of Dicker and Naude (2019), there is a relationship between MKO and exploratory play. The role of MKO in exploratory play is to create a safe, secure and challenging mathematical environment that will stimulate learners' curiosity (Dicker & Naude, 2019). The role of MKO is to help in expanding logical-mathematical intelligence by providing learners with a range of interesting materials (Wilmot & Schäfer, 2015) and by structuring an inviting environment (Dicker & Naude, 2019) in creative play. A creative environment can happen in any setting, regardless of a lack of financial resources.

Lastly, wordplay boosts socialisation in the classroom (Frye et al., 2013). The educator can create these resources used in this type of wordplay from flashcards and sheets. Creative games can be played after lessons when the learner understands the difference between more and less.

In conclusion, this section of the literature review contributed to the main aim of this study, namely, exploring the role of play in teaching number sense to Grade 3.

5.3 RECAP OF THE RESEARCH FINDINGS IN ADDRESSING THE RESEARCH QUESTIONS

This section recaps the central question and three sub-questions asked by this study.

5.3.1 The Central Research Question

The cemtral question was*": **What role does play perform in teaching number sense to Grade 3 learners?"***

The evidence from the literature revealed that play activities develop motor skills and help to develop communication, socialisation, problem-solving and creativity. Most relevant to this study about this finding is that play activities increase social interaction, which is an element of Vygotsky social development theory and Gardner's multiple intelligences theory (2.2.2, 2.2.3 and 2.3.1 of Chapter 2). This study found that play has two roles: participation and learner understanding of number sense.

Play increases learners' participation and addresses multiple intelligences. When learners play games, it provokes every learner's interest, and each learner with different learning abilities wants to participate in the play. Learners who participate in play tend to have a greater level of number sense. During play, a learner can act as an MKO and help others participating in the game to understand better. These findings suggest that the role of play in teaching number sense increases Grade 3 learners' number sense.

It was evident that there is a significant relationship between play and social interaction because when play opportunities increased in the teaching of number sense, social interaction also increased. This relationship can also be strengthened by collaborating with parents to create a safe, secure playing environment; this can increase learners' performance in developing number sense. Play helps learners to understand numbers and be able to exit Grade 3 with a secured number sense.

5.3.2 The First Research Sub-Question (How Can Play Be Used to Teach Number Sense to Grade 3 Learners?)

The responses to this question showed that play could be used to improve Grade 3 learners' social interaction. As recommended by Vygotsky social development, the educator's role as MKO is to facilitate play to improve learners' social interaction. The

findings further revealed that the role of the educator is to plan play in their lesson preparation to enhance Grade 3 learners' social interaction.

Other than that, the findings demonstrated that a learner could act as MKO to improve social interaction among each other as peers. A learner who acts as MKO motivates all learners to participate and communicate, encouraging teamwork between the learners and contributing to the learner's number sense knowledge and skills.

5.3.3 The Second Research Sub-Question (What Types of Play can help Teach Number Sense to Grade 3 Learners?)

The research discussion indicated that physical and musical play and wordplay are types of games that can enhance social interaction through expansion of the logical intelligence of Grade 3 learners when teaching number sense.

Participants engaged the Grade 3 learners in the following types of play when teaching number sense: skipping rope, *Tsheretshere* and back-to-nought, a card-game called nearest tenth and game-songs. Table 5.1 summarises the connexion between the types of play from the literature and those from the merged findings.

Table 5.1: Types of play

Type of play	Example	Function in the teaching and learning of number sense integrated with other mathematical concepts
Physical	Skipping rope, Tsheretshere	Learn number concepts
Wordplay	Back-to-nought, card-game (nearest tenth)	Increases social interaction
Musical play	Game-songs (count and sing)	Counting numbers, backward and forward

It became apparent that educators mostly used physical play (indigenous games) because they did not require funds and resources for creation. Physical play requires only the educator's creativity to integrate play in the Grade 3 number sense lessons. This result suggests that physical play (especially that involves indigenous games) is the type of play that can be recommended to teach number sense because games are easy to create with fewer resources that are obtainable from the physical environment, and they require outdoor space where social distancing can be observed in the Covid-19 pandemic. The researcher found that when physical play was integrated with other

subjects, it led to Grade 3 learners' holistic development. For example, when integrated with Home Languages, play increases Grade 3 learners' language development due to social interaction. When integrated with Life Skills, this helps to develop Grade 3 learners' gross and fine motor skills. Indigenous games can help learners with cultural issues in this 4th Industrial Revolution (4IR). Indigenous games seem to be less often played by many children at school because of the dynamic change of culture due to technological developments where learners play games on their Ipads and smartphones to learn number sense.

5.3.4 The Third Research Sub-Question (What Guidelines Do Educators Follow When Integrating Play in the Teaching of Number Sense?)

It should be noted that the findings for this question serve as the basis for the development of guidelines for the use of play when teaching number sense. In summary, the findings of relevance are:

- The policy gap explained in Theme 2: Integration of play when teaching number sense (Section 4.4.2) highlights the results of a lack of knowledge of play integration in teaching and learning. This conclusion is supported by the inconsistency in the educators' lesson plans where some included play and others did not.
- Difficulties in following lesson plans: document analysis and observation corroborated that educators used play as an intervention strategy, not a teaching and learning strategy.
- Teaching and learning activities time management: the lack of guidelines for integration of play resulted in poor planning and prolonged lessons without clear learning outcomes.

5.4 LIMITATIONS OF THE STUDY

The findings of this study were subject to at least two limitations:

- Firstly it was conducted only in the Lebopo Circuit of Capricorn South District with a small number of educators. Its findings cannot, therefore, be generalised to explain the role of play in teaching number sense to Grade 3 learners in the whole of Capricorn district (Limpopo).

- Secondly, even though this study used semi-structured interviews, document analysis, and non-participant observation and the results were triangulated, participant bias could have influenced the findings.

5.5 CONCLUSIONS

Section 5.3 of this Chapter connected the merged findings with the aim and objectives of this study in Section 1.3.2 of Chapter 1. In this section, the final analysis of this study addressed the research questions framed in section 1.3.1 of Chapter 1. Refocusing on reflecting on the research questions, the researcher began by exploring the research questions and providing the answers based on the findings.

The central research question was: *What role does play perform in teaching number sense to Grade 3 learners*? The research sub-question 1 was: *How can play be used to teach number sense to Grade 3 learners*? The research sub-question 2 was: W*hat types of play can help to teach number sense to Grade 3 learners*? The research sub-question 3 was: *What guidelines do educators follow when integrating play in the teaching of number sense*? These questions were explored together because they examined the role of play in teaching number sense to Grade 3 learners.

5.5.1 Conclusions on the Central Research Question

Supreme in exploring this question are the findings inferred from Theme 1: “The role of play when teaching number sense” (Section 4.4.1) in Chapter 4. The role of play in teaching number sense to Grade 3 learners is socialisation, which helps learners develop number sense and participate during teaching and learning.

5.5.2 Conclusions on the Research Sub-Question 1

Research sub-question 1 was: “How can play be used to teach number sense to Grade 3 learners”? Theme 3 emerged from this question: The use of play to improve social interaction (Section 4.3.3). The participants shared their views and experiences that validated the conclusions from the literature review that indicated that different types of games can be used to improve social interaction. It is further concluded that the role of MKO is to integrate play in the teaching and learning of number sense to improve socialisation.

5.5.3 Conclusions on Research Sub-Question 2

Research sub-question 2 was: “What types of play can help to teach number sense to Grade 3 learners?” In exploring this question, the theme: Types of play relating to logical-mathematical intelligence (Section 4.3.4) emerged. This study shows that physical play (especially involving indigenous games) is a type of play that can be used to improve social interaction that helps in enhancing the logical-mathematical intelligence of Grade 3 learners. Physical play is integrated with other subjects because it develops Grade 3 learners’ holistic development

5.5.4 Conclusions on Research Sub-Question 3

Research sub-question three was: “What guidelines do educators follow when integrating play in the teaching of number sense? This question gave rise to Theme 2: Integration of play when teaching number sense (Section 4.4.2). What was interesting about these findings was that there do not seem to be any formal guidelines to be used to integrate play because educators lacked knowledge on integration of play in teaching and learning. They used play as an intervention strategy, not a teaching and learning strategy. The literature review in Section 2.2.2 highlighted that the role of MKO is to use multiple teaching strategies and techniques in teaching number sense in a play to increase social interaction (Fu, 2010).

The above summary of findings and conclusions influences the recommendations of this study.

5.6 RECOMMENDATIONS

The recommendations offered in this section focus predominantly on the social interaction which formed the theoretical framework of this study based on two theories, namely, Vygotsky’s social development theory and Gardner’s theory of multiple intelligences. It was highlighted in Figure 2.2 of Chapter 2 that when the educator uses play to enhance logical-mathematical intelligence social interaction is also enhanced.

The recommendations below are presented on the educational hierarchy of South Africa from three levels, namely, departmental level, primary school and parents. As indicated in Chapter 1, this study took place in three public primary schools within one district (Capricorn South) in Limpopo. Since the district office represents the DBE, the

first recommendation is directed towards the district office. The second set of recommendations are for the public primary schools while the last recommendations are for the parents as stakeholders of the schools.

5.6.1 Recommendations to the Department of Basic Education

The DBE (2018) established that educators need to use a play-based approach in teaching Mathematics for learners to fully understand number sense. The National Education Collaboration Trust (NECT) is an organisation that has a contract with DBE to develop lesson plans for English, Mathematics, and Sepedi for educators in Grade 1 to 3. From the lesson plans provided by the DBE, educators need to prepare their own lessons. However, this study focuses on a play-based approach in teaching number sense in Grade 3 only. It found that play was mentioned only in some of the activities in mental math. This might be due to the absence of guidelines on how a play should be carried out from lesson preparation to assessment. This study makes the following recommendations that encourage close collaboration between DBE and NECT:

- **Recommendation 1**: From the findings, educators do not have guidelines on the integration of play in teaching number sense to Grade 3 learners. The Mathematics lesson plans from NECT should have a clear indication of the type of play that an educator can use to improve social interaction between the participants of the lesson. There should be guidelines on how educators can integrate play into planning, introduction, presentation, and assessment. The guidelines should include the role of educators in the use of play in teaching number sense to enhance logical-mathematical intelligence.
- **Recommendation 2**: From the information drawn from the literature review chapter and findings Section 4.4 in Chapter 4, it is apparent that many educators do not know how to include play in lesson preparation, that is, lesson planning, introduction, presentation, and assessment. Grade 3 educators should be trained on the inclusion of play in lesson preparation through curriculum workshops. This will help the educators to effectively incorporate play-based approaches in lesson preparation.
- **Recommendation 3**: In the literature review (Section 2.4.2), Mntunjani et al. (2018:8) revealed that there is a relationship between the use of mathematical

resources and socialisation during play. From the aforementioned, this study recommends that DBE should support educators by delivering printed resources to schools through the circuit office for educators to engage in different types of play in the teaching of number sense to improve socialisation.

5.6.2 Recommendations to Public Primary Schools

The findings in Chapter 4 showed that some educators were able to plan play activities while other educators were not able to do so. Section 4.1.2 in Chapter 4 shows that these schools are geographically close so it should be easy for them to collaborate. This study derives these recommendations that encourage close collaboration between educators who are teaching Mathematics in Grade 3 as follows:

- **Recommendation 4**: Grade 3 educators should collaborate to work as a team in using a play-based approach by planning play in their lesson preparation together. Grade 3 educators will then use similar lesson plans in a different school with the same objectives and aim of play to increase social interaction. The study by Omidire et al. (2018), findings and conclusions in sections 2.4.3, 5.3.3 and 5.5.3 respectively found that physical play (with indigenous games) is integrated with Home Languages which increases learners' language development due to social interaction, and Life Skills which helps to develop Grade 3 learners' gross and fine motor skills. Physical play and indigenous games require easily accessible no-cost resources that can be used to increase social interaction. Against this background, this study put forward the following recommendations:
- **Recommendation 5**: Due to the Covid-19 pandemic, physical play is preferred because it allows for social distancing between learners and their educators. In addition, indigenous games can be used in physical play. Educators can use physical play to teach number sense and to assess physical education outcomes while home language skills can be developed from the same lesson. Educators should have separate lesson plans for Mathematics, Life Skills and Home Language that include physical play.
- **Recommendation 6:** Educators can use physical play in teaching number sense to enhance social interaction. In this setting, educators can access some resources for play from their surrounding physical environment or by creating their resources from flashcards and sheets if they do not have bought resources.

5.6.3 Recommendations to Parents

From the literature (Section 2.2.3), Rosli and Lin (2018) discussed that parents can act as the MKO to strengthen socialisation during play. Educators need to collaborate with parents in creating a safe environment for the playset. The findings from Chapter 4 revealed that learners from this study mostly stayed with their illiterate grandparents who believed in ancient culture. The grandparents have background knowledge about indigenous games and how they can teach children number sense. Thus, this study makes the following recommendation for close collaboration between educators and parents:

- **Recommendation 7**: Educators should engage parents in creating a safe and secure play environment for their children. For example, parents should play the role of MKO to guide and instruct children when playing indigenous games at home. Hopefully, this guidance from the MKO to the learners will encourage socialisation that supports understanding number sense and participation in a lesson.

5.7 SUGGESTED GUIDELINES FOR EDUCATORS IN EFFECTIVELY USING PLAY TO TEACH NUMBER SENSE

The last research sub-question 3 is answered by this section of the study: *What guidelines do educators follow when integrating play in the teaching of number sense*? The suggested guidelines incorporate MKO and social interaction as elements of Vygotsky's social development theory (Section 2.2.1) and the logical-mathematical intelligence from Gardner's theory of multiple intelligences (Section 2.3)

The findings presented in Chapter 4 (Section 4.4) mapped the suggested guidelines to help educators to use play when teaching number sense. It was indicated in Chapter 1 (Section 1.4) and Chapter 2 (Section 2.2.2) that play includes the role of MKO. The findings in Chapter 4 (Section 4.4.4) revealed that educators prefer indigenous games and physical play in their mathematical teaching and learning activities. Against this backdrop, the researcher recommends using indigenous games and physical play because they are accessible, affordable, and allow social distancing as one of the Covid-19 regulations. These recommended types of play can be adapted specifically

for teaching number sense; however, their effectiveness can only be evaluated when they are used.

The suggested guidelines are titled: *Guidelines for the use of play when teaching number sense.* The guidelines are divided into three steps: Step 1: link play with the learning outcomes in the lesson plans; Step 2: integrate play in the teaching and learning activities; and Step 3: assessment should form part of the same play. These play guidelines resonate with the interpretivism paradigm, which underpinned this study. The interpretivism paradigm was explained in detail in Chapter 1 (Section 1.5.3).

5.7.1 Framework for the Design of the Use of Play Guidelines.

Using the presented findings and the discussions in sections 4.3 and 4.4 in Chapter 4 and the recommendations in Section 5.6, as well as the theoretical framework discussed in Section 2.2, a framework of guidelines for the use of play when teaching number sense is proposed. The framework is presented visually in Figure 5.1. This figure incorporates Figure 2.2 in Chapter 2. Figure 2.2 illustrates the relationship between the two theories that form the theoretical framework that underpins this study. The theoretical framework for this study played a fundamental role in the design of guidelines about the use of play when teaching numbers. The common concept interconnected the two theories is a social interaction that informed the design and the implementation of the guidelines. The visual overview of the guidelines is illustrated in Figure 5.1.

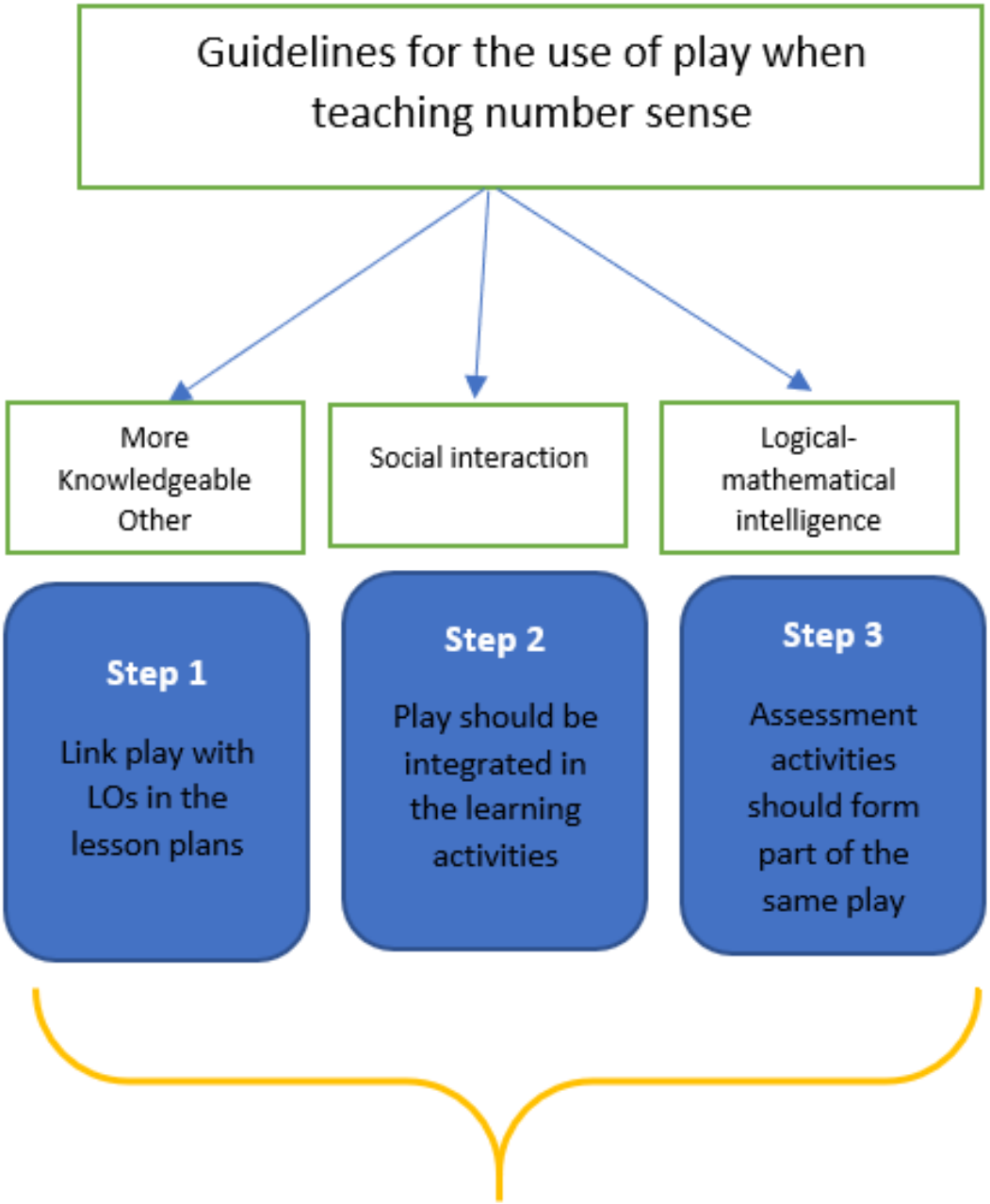


Figure 5.1: The suggested guidelines on the use of play when teaching number sense

Figure 5.1 illustrates the elements of the two theories that formed part of this study's theoretical framework. The elements indicate that play should start with an MKO (the educator) who should ensure that the learning activities develop social interaction. Most importantly, since play is used to teach number sense, it should stimulate logical-mathematical intelligence.

5.7.2 The Guidelines on the Use of Play When Teaching Number Sense.

It should be noted that the use of play when teaching number sense guidelines illustrated in Figure 5.1 aim to help educators to integrate play in their teaching of the number sense. Educators can use the suggested guidelines within the context of their schools (such as the availability of games and the types of indigenous games played in the community). The guidelines should be incorporated into the lesson preparation.

Step 1: Link play with the learning outcomes in the lesson plan

Step 1 is an educator-centred process as it involves lesson preparation. The educator as MKO should consider the lesson's learning outcomes and select the type of play guided by the learning outcomes. During this step, the educator should outline how the play will be used in the different stages of the lesson; for example, to introduce a lesson during the presentation or as an assessment activity. If the learning activity is to count in 2s, the educator can suggest *diketo*, a game which learners can play in pairs.

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Figure 5.2: Children playing *diketo*

This game can introduce the lesson where learners can count the stones in 2s into the drawn circle. During the presentation, they can play the game by making sure that when they throw one stone up, they scoop many stones from the circle, throw the stone up again, and push all other stones out to leave only 2. For assessment

purposes, the winners will get points that the educator will record on the observation checklist.

Step 2: Play should be integrated into the learning activities.

As explained in Step 1, the learning activity is counting in 2s. In this step, the educator should illustrate how play is used in the teaching and learning activities considering the ZPD, which is part of Vygotsky's social development theory. The educator should select a game that will allow them to exercise the role of MKO and to support the learners in their ZPD. Most importantly, the play should encourage social interaction. With the play selected in the first step (*diketo*), the educator can start by giving instructions, setting the game's rules out for the learners and demonstrating to the learners by playing with one learner. The educator can move around and support struggling learners until they are on par with other learners. Learners should be encouraged to communicate the rules and their points.

Step 3: Assessment activities should form part of the same play.

Assessment is an integral process of teaching and learning activities that intermediates between the educators and learners in the classroom. Amua-Sekyi (2016:1) defined assessment as all activities that educators use to evaluate learners' abilities and strengths that can then be used to modify teaching and learning. Since this study focuses on Grade 3 learners (who are part of the Foundation Phase in the South African schooling system), their assessment is mainly based on educator observation. In this step, assessment can be continuous throughout the lesson as the educator will be observing the learners as they play *diketo*.

In conclusion, educators should note that they should adapt the guidelines and use them to suit their school context. It should also be noted that play creates a ZPD in a learner. Irvin (2017:4) established that through play learners tend to display more mature behaviours than the expected daily behaviours of their average age group. Irvin (2017:4) further posited that when learners are given opportunities to play, they improve in every developmental aspect.

5.8 CONCLUDING REMARKS

This study explored the role of play in teaching number sense to Grade 3 learners. The findings of this study showed educators are having difficulties in using play when teaching number sense. Recommendations and guidelines were recommended for educators to effectively using play to teach number sense to Grade 3 learners.

Guidelines were developed demonstrating three steps that can be followed by Grade 3 educators in using play to teach number sense. It was also recommended that educators can use indigenous games as they do not require cost resources.

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APPENDICES

APPENDIX A: A LIST OF SELECTED PARTICIPANTS AND THEIR SCHOOLS

PARTICIPANT	SCHOOLS
Educator 1	School 1
Educator 2	School 2
Educator 3	School 3
Educator 4	School 4
Educator 5	School 5
Educator 6	School 6

APPENDIX B: UNISA RESEARCH ETHICS APPROVAL

UNISA university of south africa

UNISA COLLEGE OF EDUCATION ETHICS REVIEW COMMITTEE

Date: 2020/10/14

Ref: **2020/10/14/64019209/07/AM**
Name: Ms MA Selepe
Student No.:64019209

Dear Ms MA Selepe

Decision: Ethics Approval from 2020/10/14 to 2023/10/14

Researcher(s): Name: Ms MA Selepe
E-mail address: 64019209@mylife.unisa.ac.za
Telephone: 0826495911

Supervisor(s): Name: Dr RSS Mphahlele
E-mail address: Emphahrs@unisa.ac.za
Telephone: 0124294941

Title of research:

THE ROLE OF PLAY IN TEACHING NUMBER SENSE TO GRADE 3 LEARNERS

Qualification: MEd EARLY CHILDHOOD EDUCATION

Thank you for the application for research ethics clearance by the UNISA College of Education Ethics Review Committee for the above mentioned research. Ethics approval is granted for the period 2020/10/14 to 2023/10/14.

*The **medium risk** application was reviewed by the Ethics Review Committee on 2020/10/14 in compliance with the UNISA Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.*

The proposed research may now commence with the provisions that:

1. The researcher will ensure that the research project adheres to the relevant guidelines set out in the Unisa Covid-19 position statement on research ethics attached.
2. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.

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www.unisa.ac.za

3. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the UNISA College of Education Ethics Review Committee.
4. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
5. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing.
6. The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study. Adherence to the following South African legislation is important, if applicable: Protection of Personal Information Act, no 4 of 2013; Children's act no 38 of 2005 and the National Health Act, no 61 of 2003.
7. Only de-identified research data may be used for secondary research purposes in future on condition that the research objectives are similar to those of the original research. Secondary use of identifiable human research data requires additional ethics clearance.
8. No field work activities may continue after the expiry date **2023/10/14**. Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.

Note:

The reference number **2020/10/14/64019209/07/AM** *should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.*

Kind regards,

Prof AT Motlhabane
CHAIRPERSON: CEDU RERC
motlhat@unisa.ac.za

Prof PM Sebate
EXECUTIVE DEAN
Sebatpm@unisa.ac.za

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
www.unisa.ac.za

APPENDIX C: REQUEST PERMISSION TO CONDUCT A RESEARCH TO THE LIMPOPO DEPARTMENT OF EDUCATION

Enquiries: Ms Selepe MA

Persal no: 84719591

Contact details: 0826495911

Date: 16 October 2020

The District Director

Capricorn South District

Private bag x70

Lebowakgomo

0737

REQUEST FOR PERMISSION TO CONDUCT RESEARCH IN CAPRICORN SOUTH SCHOOLS

I, Mmakgabo Angelinah Selepe hereby request permission to conduct research in Boshega, Moefadi and Sehlale primary schools in Capricorn South District (Lebopo Circuit). These schools were selected based on proximity and the fact that they are situated in the area where I work. I am a masters student at the University of South Africa, conducting research under supervision of Dr RSS Mphahlele, a senior lecturer in the Department of Early Childhood Education, The title of my study is the role of play in teaching number sense to Grade 3 learners. I applied for ethical clearance and was approved by UNISA College of Education Ethics Review Committee with reference no: **2020/10/14/64019209/07/AM**. The aim of the study is to explore the role of play in teaching number sense to grade 3 learners. This will be done through engaging the Grade 3 teachers using unstructured interviews in order to gather their views and experiences. To corroborate teachers' responses from the interviews about the use play in teaching number sense to grade 3 learners. The interviews will be done outside school working hours from 13h30 to 14h30. I will request copies of lesson plans, learner's classwork books and workbooks from the grade 3 teachers with the consent of parents. If given permission, the copies will be sent through email with all names replaced with pseudonyms for anonymity and confidentiality reasons. To triangulate the data collected from the interviews and documents, I will conduct formal observations where I will observe and record information formally without participating in the classroom activities. I will observe one classroom for 40 minutes

This study will contribute to the teaching and learning body of knowledge by identifying the role of play in the implementation of learning through play prescribed in the National Curriculum Statement. There are no potential risks anticipated however, participants will be advised that they are free to withdraw any time they feel uncomfortable. Anonymity and confidentiality will be observed at all times. There will be no reimbursement or incentives for participation in this research. Participants should participate voluntarily. Feedback will be given after completing the thesis through dissemination workshop. The completed dissertation will be made available to all participants.

Yours sincerely

(signature)

Mmakgabo Angelinah Selepe

mmakgaboangelinah@gmail.com

Researcher

APPENDIX D: APPROVAL TO CARRY OUT RESEARCH FROM LIMPOPO DEPARTMENT OF EDUCATION

LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
EDUCATION

CONFIDENTIAL

Ref: 2/2/2 Enq: Makgati DC Tel No: 015 290 9409 E-mail:MakgatiDC@edu.limpopo.gov.za

Selepe MA
Private Bag x1108
Sovenga
0742

RE: REQUEST FOR PERMISSION TO CONDUCT RESEARCH

1. The above bears reference.

2. The Department wishes to inform you that your request to conduct research has been approved. Topic of the research proposal: **"THE ROLE OF PLAY IN TEACHING NUMBER SENSE TO GRADE 3 LEARNER "**

3. The following conditions should be considered:

3.1 The research should not have any financial implications for Limpopo Department of Education.

3.2 Arrangements should be made with the Circuit Office and the School concerned.

3.3 The conduct of research should not in anyhow disrupt the academic programs at the schools.

3.4 The research should not be conducted during the time of Examinations especially the fourth term.

3.5 During the study, applicable research ethics should be adhered to; in particular the principle of voluntary participation (the people involved should be respected).

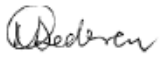
REQUEST FOR PERMISSION TO CONDUCT RESEARCH: SELEPE MA

3.6 Upon completion of research study, the researcher shall share the final product of the research with the Department.

4 Furthermore, you are expected to produce this letter at Schools/ Offices where you intend conducting your research as an evidence that you are permitted to conduct the research.

5 The department appreciates the contribution that you wish to make and wishes you success in your investigation.

Best wishes.



29-10-2020

Mrs Dederen KO
Acting Head of Department

Date

APPENDIX E: PERMISSION LETTERS TO THE SCHOOL PRINCIPAL

Enquiries: Ms Selepe MA

Contact details: 0826495911

Date: 02 November 2020

The principal

Moefadi Primary School

P.O Box 0851

Ga Madiba, Mokopane

Date: 02 November 2020

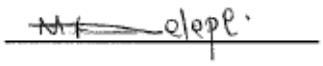
REQUEST FOR PERMISSION TO CONDUCT RESEARCH IN YOUR SCHOOLS

I, Mmakgabo Angelinah Selepe hereby request permission to conduct research in your school. Your school is selected based on proximity and the fact that they are situated in the area where I work. I am a masters student at the University of South Africa, conducting research under supervision of Dr RSS Mphahlele, a senior lecturer in the Department of Early Childhood Education, The title of my study is the role of play in teaching number sense to Grade 3 learners. I applied for permission to conduct a research in Capricorn South District from Department of Education and I was granted. The aim of the study is to explore the role of play in teaching number sense to grade 3 learners. This will be done through engaging the Grade 3 teachers using unstructured interviews in order to gather their views and experiences. To corroborate teachers' responses from the interviews about the use play in teaching number sense to grade 3 learners. The interviews will be done outside school working hours from 13h30 to 14h30. I will request copies of lesson plans, learner's classwork books and workbooks from the grade 3 teachers with the consent of parents. If given permission, the copies will be sent through email with all names replaced with pseudonyms for anonymity and confidentiality reasons. To triangulate the data collected from the interviews and documents, I will conduct formal observations where I will observe and record information formally without participating in the classroom activities. I will observe two classes for 40 minutes

This study will contribute to the teaching and learning body of knowledge by identifying the role of play in the implementation of learning through play prescribed in the National

Curriculum Statement. There are no potential risks anticipated however, participants will be advised that they are free to withdraw any time they feel uncomfortable. Anonymity and confidentiality will be observed at all times. There will be no reimbursement or incentives for participation in this research. Participants should participate voluntarily. Feedback will be given after completing the thesis through dissemination workshop. The completed dissertation will be made available to all participants.

Yours sincerely

 **(signature)**

Mmakgabo Angelinah Selepe

mmakgaboangelinah@gmail.com

Researcher

APPENDIX F: CONSENT LETTER TO PARTICIPANTS

CONSENT TO PARTICIPATE IN THIS STUDY

I, _____ (participant signature), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty (if applicable).

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

I agree to the recording of the Interviews

I have received a signed copy of the informed consent agreement.

_____ _____

Participant Signature Date

Researcher's Name & Surname (please print) Mmakgabo Angelinah Selepe_____

_____ _____

Researcher's signature Date

APPENDIX G: ASSENT LETTER TO PARENTS

LETTER REQUESTING PARENTAL CONSENT FOR MINORS TO PARTICIPATE IN A RESEARCH PROJECT

Dear Parent

Your child is invited to participate in a study entitled the role of play in teaching number sense to Grade 3 learners.

I am undertaking this study as part of my master's research at the University of South Africa. The purpose of the study is to explore the role of play in teaching number sense to Grade 3 learners and the possible benefits of the study are the improvement of Mathematics. I am asking permission to include your child in this to collect data from his/her classwork books and workbooks from the activities given by his/her educator. I expect to have your child and other children participating in the study.

If you allow your child to participate, I shall request him/her to:

- Take part in a document analysis where the researcher will ask your child's educator to send your child's work from classwork books and workbooks through e-mail.

Any information that is obtained in connection with this study and can be identified with your child will remain confidential and will only be disclosed with your permission. His/her work will not be linked to his/her name or your name or the school's name in any written or verbal report based on this study. Such a report will be used for research purposes only.

There are no foreseeable risks to your child by participating in the study. Your child will receive no direct benefit from participating in the study; however, the possible benefits to education are educators understanding how play can be used to teach Mathematics in the Foundation Phase. Neither your child nor you will receive any type of payment for participating in this study.

Your child's participation in this study is voluntary. Your child may decline to participate or to withdraw from participation at any time. Withdrawal or refusal to participate will not affect him/her in any way. Similarly you can agree to allow your child to be in the study now and change your mind later without any penalty.

The study will take place during regular classroom activities with the prior approval of the school and your child's teacher. However, if you do not want your child to participate, there is no other alternative activity will be available.

In addition to your permission, your child must agree to participate in the study and you and your child will also be asked to sign the assent form which accompanies this letter. If your child does not wish to participate in the study, he or she will not be included and there will be no penalty. The information gathered from the study and your child's participation in the study will be stored securely on a password-locked computer in my locked office for five years after the study. Thereafter, records will be erased.

The benefits of this study are educators understanding how play can be used to teach Mathematics in the Foundation Phase.

There are no potential risks

There will be no reimbursement or any incentives for participation in the research.

If you have questions about this study please ask me or my study supervisor, Dr RSS Mphahlele, Department of EARLY CHILDHOOD EDUCATION, College of Education, University of South Africa. My contact number is 0826495911/0672762321 and my e-mail is mmakgaboangelinah@gmail.com. The e-mail of my supervisor is Emphars@unisa.ac.za. Permission for the study has already been given by your principal and the Ethics Committee of the College of Education, UNISA.

You are deciding to allow your child to participate in this study. Your signature below indicates that you have read the information provided above and have decided to allow him or her to participate in the study. You may keep a copy of this letter.

Sincerely

_____ _____

Parent/guardian's signature: Date:

Mmakgabo Angelinah Selepe _____ _____

Researcher's name (print) Researcher's signature Date:

APPENDIX H: ASSENT LETTER TO A CHILD

A LETTER REQUESTING ASSENT FROM LEARNERS IN A PRIMARY SCHOOL TO PARTICIPATE IN A RESEARCH PROJECT

Dear learner Date_____

My name is Teacher Mmakgabo Angelinah Selepe and would like to ask you if I can use your classwork books and workbooks to collect data from them. I am trying to learn more about how children learn number sense through play when they are taught by their educators as well as when they play with their friends.

If you say YES to do this, I will ask your teacher to send your Mathematics classwork books and workbooks copies through e-mail.

I will also ask your parents if you can take part. If you do not want to take part, it will also be fine with me. Remember, you can say yes or you can say no and no one will be upset if you don't want to take part or even if you change your mind later and want to stop. You can ask any questions that you have now. If you have a question later that you didn't think of now, ask me through Microsoft Teams because I cannot come to your school because of nation lockdown due to Covid-19.

Please speak to mommy or daddy about taking part before you sign this letter. Signing your name at the bottom means that you agree to be in this study. A copy of this letter will be given to your parents.

Regards

Teacher Mmakgabo Angelinah Selepe

Your Name	Yes, I will take part 	No, I don't want to take part 
Name of the researcher		
Date		
Witness		

APPENDIX I: INTERVIEW SCHEDULE

Grade 3 Educator

1. What is your highest qualification?

_____

2. How many years have you been a Foundation Phase teacher?

3. Have you taught any other phase?

_____

4. Till what Grade did you do Mathematics in school?

5. Did you experience difficulty in Mathematics at school?

6. Do you experience difficulty teaching Mathematics? Elaborate.

_____

7. What are your views about the use of play when teaching number sense?

8. What role does play perform in the teaching of number sense?

8. How do you use play when teaching number sense?

9. Do you use play when planning your lessons?

10. Do you always follow your lesson plan? If no, explain.

11. Do your lessons always go as planned? Explain.

12. What is the purpose of using play when teaching number sense?

13. What is your opinion about securing number sense to Grade 3 learners? Is it more important than the other concepts? Elaborate.

APPENDIX J: DOCUMENT ANALYSIS TOOL

Document analysis tool

- **Did the educator use play in the planning of the lesson?**
- **How did the educator use play when planning the lesson**
- **What types of play did the educator use in the lesson plan?**

- **Did the educator give the learner's task that equivalent to what she/he was teaching about?**
- **Did learners score all marks to show that play helped them to understand a concept better?**
- **Does the task given in the classwork book similar to workbooks?**
- **How did the role of play perform in the teaching of number sense?**

APPENDIX K: OBSERVATION SCHEDULE

Observation question	Yes/No	Comment
Did the educator use the planned lesson?		
Did the educator follow the lesson plan?		
Did the educator use play to teach learners?		
Did the educator use the relevant type of play for the topic?		
Where the role of play in teaching and learning number sense evidently?		
Was social interaction among learners and educators evident?		
Did learners fully participate in play?		

APPENDIX L: APPROVAL FROM SCHOOL PRINCIPAL SCHOOL 3

School 3

PRIMARY SCHOOL

PO BOX [illegible]
Ga Molepo [illegible]
POLOKWANE
0700

contact no:
072 677 0057 / 082 520 7634

EMAIL :

Dear Sir/Madam

RE: Letter of aknowledgement

1. The above matter bares reference
2. This is to aknowledge that Mmakgabo Angelinah Selepe did conduct research in our school with grade 3 educators who are teaching mathematics.

Hoping that you will find this in order

Thank you

Nchabeleng MD (Principal)

DEPARTMENT OF EDUCATION
[illegible] PRIMARY SCHOOL
04 NOV 2020
P.O. BOX [illegible] POLOKWANE 0700
LIMPOPO PROVINCE

EMAIL :

contact no:
072 677 0057 / 082 520 7634

APPENDIX M: PARTICIPANTS CONSENT FORM

CONSENT TO PARTICIPATE IN THIS STUDY

I, _____ (participant signature), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

1) I have read (or had explained to me) and understood the study as explained in the information sheet.
2) I have had sufficient opportunity to ask questions and am prepared to participate in the study.
3) I understand that my participation is voluntary and that I am free to withdraw at any time without penalty (if applicable).
4) I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.
5) I agree to the recording of the interviews.
6) I have received a signed copy of the informed consent agreement.

_____ 04/11/2020

Participant Signature Date

Researcher's Name & Surname (please print) Mmakgabo Angelinah Selepe

_____ 04/11/2020

Researcher's signature Date

APPENDIX N: PARENTS CONSENT FORM

LETTER REQUESTING PARENTAL CONSENT FOR MINORS TO PARTICIPATE IN A RESEARCH PROJECT

Dear Parent

Your child is invited to participate in a study entitled the role of play in teaching number sense to grade 3 learners.

I am undertaking this study as part of my master's research at the University of South Africa. The purpose of the study is explore the role of play in teaching number sense to grade 3 learners and the possible benefits of the study are the improvement of Mathematics. I am asking permission to include your child in this to collect data from his/her classwork books and workbooks from the activities given by his/her educator. I expect to have your child and other children participating in the study.

If you allow your child to participate, I shall request him/her to:

- Take part in a document analysis where the researcher will ask your child's educator to send your child's work from classwork books and workbooks through email.

Any information that is obtained in connection with this study and can be identified with your child will remain confidential and will only be disclosed with your permission. His/her work will not be linked to his/her name or your name or the school's name in any written or verbal report based on this study. Such a report will be used for research purposes only.

There are no foreseeable risks to your child by participating in the study. Your child will receive no direct benefit from participating in the study; however, the possible benefits to education are educators understanding the manner in which play can be used to teach mathematics in foundation phase. Neither your child nor you will receive any type of payment for participating in this study.

Your child's participation in this study is voluntary. Your child may decline to participate or to withdraw from participation at any time. Withdrawal or refusal to participate will not affect him/her in any way. Similarly you can agree to allow your child to be in the study now and change your mind later without any penalty.

The study will take place during regular classroom activities with the prior approval of the school and your child's teacher. However, if you do not want your child to participate, there is no other alternative activity will be available.

In addition to your permission, your child must agree to participate in the study and you and your child will also be asked to sign the assent form which accompanies this letter. If your child does not wish to participate in the study, he or she will not be included and there will be no penalty. The information gathered from the study and your child's participation in the study will be stored securely on a password locked computer in my locked office for five years after the study. Thereafter, records will be erased.

The benefits of this study are educators understanding the manner in which play can be used to teach mathematics in foundation phase.

There are no potential risks

There will be no reimbursement or any incentives for participation in the research.

If you have questions about this study please ask me or my study supervisor, Dr RSS Mphahlele, Department of Early Childhood Education, College of Education, University of South Africa. My contact number is 0826495911/0672762321 and my e-mail is mmakgaboangelinah@gmail.com . The e-mail of my supervisor is Emphars@unisa.ac.za . Permission for the study has already been given by your principal and the Ethics Committee of the College of Education, UNISA.

You are making a decision about allowing your child to participate in this study. Your signature below indicates that you have read the information provided above and have decided to allow him or her to participate in the study. You may keep a copy of this letter.

Sincerely

M G Mabo e	04/11/2020	
Parent/guardian's signature:	Date:	
Mmakgabo Angelinah Selepe	Selepe	04/11/2020
Researcher's name (print)	Researcher's signature	Date:

APPENDIX O: LEARNER ASSENT FORM

A LETTER REQUESTING ASSENT FROM LEARNERS IN A PRIMARY SCHOOL TO PARTICIPATE IN A RESEARCH PROJECT

Dear learner

Date 04/11/2020

My name is Teacher Mmakgabo Angelinah Selepe and would like to ask you if I can use your classwork books and workbooks to collect data from them. I am trying to learn more about how children learn number sense through play when they are taught by their teachers as well as when they play with their friends.

If you agree to participate in this study, I will ask your teacher to send your Mathematics classwork books and workbooks copies through email. I will also ask your parents if you can take part. If you do not want to take part, it will also be fine with me. Remember, you can say yes or you can say no and no one will be upset if you don't want to take part or even if you change your mind later and want to stop. You can ask any questions that you have now. If you have a question later that you didn't think of now, ask me through Microsoft teams because I cannot come to your school because of nation lockdown due to covid-19.

Please speak to mommy or daddy about taking part before you sign this letter. Signing your name at the bottom means that you agree to be in this study. A copy of this letter will be given to your parents.

Regards

Teacher Mmakgabo Angelinah Selepe

Your Name	Yes I will take part 	No I don't want to take part 
Name of the researcher	Teacher Selepe	
Date	04/11/2020	
Witness	M.G Maboa	

APPENDIX P: SAMPLE OF INTERVIEW TRANSCRIPT

Educator 1

Q: What is your highest qualification?

R: My highest qualification is BEd Honours.

Q: How many years have you been a Foundation Phase teacher?

R: Mm, I was Foundation Phase teacher and then were removed to the higher grades and then be back approximately maybe ten years.

Q: Till what grade did you do Mathematics in school?

R: Grade 11.

Q: Did you experience difficulty in Mathematics at school?

R: Yes. I left the Maths stream and followed the general stream.

Q: Okay. Do you experience difficulty in teaching Mathematics?

R: In the Foundation Phase, no.

Q: Please elaborate?

R: I don’t understand what you mean by elaborate?

Q: If you are not experiencing any difficulty in teaching Mathematics now in Foundation Phase, why are you saying you are not experiencing any difficulty?

R: In my side, not in the side of the learners?

Q: Yes.

R: On my side, I can say I manage to use new techniques to teach and I found those techniques to be successful.

Q: Thank you. What are your views about the use of play with teaching numbers?

R: I think learning through play is it what you mean?

Q: About the use of play?

R: The use of play, I find it very useful because it is learner-centred, the learners become actively involved and they are learning and understand quickly.

Q: What role does play perform in teaching numbers?

R: What role?

Q: Yes.

R: I can say by roles, I don't get you very well, but I think you mean what is the importance?

Q: Yes.

R: Learners like to play very much, they learn freely when they do it through playing because you engage them more, unlike to be serious teacher-centred, so through play, they become, it becomes easy for them to understand.

Q: Okay, how do you use play when teaching number sense?

R: By involving learners, can I give you a scenario. Maybe I am teaching say the rounding off of numbers, rounding off to the nearest ten. Can I use, the rounding off of numbers?. So, I usually bring some of the learners to the front and use them to say this one is ten, twenty, thirty and forty and so on and so on, so using the flashcards by giving those learners written numbers, maybe say I want a learner to round off 79 to the nearest 10, so I raise a flashcard then the learner takes that flashcard and give the one who gave the correct answer.

Q: Okay, thank you. Do you use play when planning lessons?

R: When planning, no. I just involve it when I am busy teaching, maybe if I have a difficult word, learners will not understand, I switch to the play.

Q: Okay. Do you always follow your lesson plan? If no, explain.

R: Not necessarily, because my learners usually are the ones who direct me, sometimes I may find myself to be totally out, or maybe slightly out of the lesson plan, due to the fact that they do not understand a certain item from my lesson plan, then I will find myself deviating from that lesson plan.

Q: Okay. Thank you. Do your lessons always go as planned, explain?

R: As planned, say maybe I am teaching place value, then I stick to it, strictly.

Q: Then say, you planned a lesson, on the piece of paper, do you always follow it as it is?

R: Raw as it is?

Q: Yes.

R: No, not 100%.

Q: Please explain?

R: As I have said earlier on, that sometimes I found myself deviated due to the fact that my learners are understanding the concept, maybe I have to take to this thing in the past and then found that this lesson is a follow-up lesson plan, though if they don't get that concept straight, I deviate.

Q: Okay, thank you. What is the purpose of using play when teacher numbers?

R: To make learners understand is the main purpose. You are saying the main purpose of using play in my lessons?

Q: When teaching numbers?

R: When teaching numbers?

Q: Yes.

R: Ja, to make them understand fully what I am teaching them, and then to make them to be able to use the teaching in the class practically at home, what I have told them, they must also practise it at home, where necessary.

Q: Okay, thank you. What is your opinion about securing number sense to Grade 3 learners? Is it more important than the other concepts? Elaborate?

R: Numbers? Yes, because it is a starting point of Mathematics when learners are able to understand numbers, I think Mathematics will not be a problem to them, if they can

have a core foundation, in numbers, and then measurement and in patterns will not give them a problem also.

Q: Okay, thank you so much.

APPENDIX Q: SAMPLE OF OBSERVATION SCHEDULE

CLASSROOM 2

Observation question	Yes/No	Comment
Did the educator use the planned lesson?	yes	The educator used a planned lesson even though she added some of the things that were not there in the lesson plan.
Did the educator follow the lesson plan?	no	The educator did not use play when planning the lesson but she switched to the game when she saw that some learners are having difficulties in understanding the patterns of numbers she was teaching.
Did the educator use play to teach learners?	yes	The educator introduced a lesson with musical play. The educator sang a song while counting numbers. The educator asked one learner to lead a song.
Did the educator use the relevant type of play for the topic?	yes	The educator used a musical play using a song to count and the lesson plan was about comparing numbers, counting forward and backwards. The educator again used physical play when congratulating a learner after understanding the pattern of numbers. They were stamping their feet together with hands while counting. The rhythm helped them to understand what number comes after the other.
Was the role of play in teaching and learning number sense evidently?	yes	All learners were participating fully in the lesson because the educator drew their attention from musical play. All learners are raising their hands to answer the questions asked by the educator.
Was social interaction among learners and educators evident?	yes	The educator called one learner to the front to show the numbers that they are calling. The learner was so motivated. The social interaction is increased when learners were participating in stamping feet and clapping hands while counting. One learner did not follow the rhythm of stamping and the other one helped the one who was struggling to stamp hands and feet while counting by communicating with him. “Aowa re betha diatla le matsong ka nako e tee gomme ra bitsa nomoro”.
Did learners fully participate in play?	yes	All learners were participating in the play. Learners were more interested in what is going to happen next.

APPENDIX R: SAMPLE OF DOCUMENT ANALYSIS

Document analysis tool EDUCATOR 4

- Did the educator use play in the planning of the lesson?

Yes

- How did the educator use play when planning the lesson?

The educator planned step-by-step on how to play the game and wrote the objectives of the game and teaching and learning activities. The educator again explained the rules of the game and how she will assist learners to play the game. More interestingly, the educator is going to participate in the game by being part of the team.

- What types of play did the educator use in the lesson plan?

Physical play

- Did the educator give the learner's task that is equivalent to what she/he was teaching about?

Yes, the educator gave learners tasks about counting and addition.

- Did learners score all marks to show that play helped them to understand the concept better?

Yes. The play helped learners to understand counting and addition better

- Does the task given in the classwork book similar to workbooks?

Yes they are similar

- How did the role of play perform in the teaching of number sense?

1. Improved communication skills

2. Increased social interaction

3. Increased interest in the lesson especially when the educator was playing

4. Increased participation

5. Enhances concentration

APPENDIX S: REQUEST FOR PARENTS TO ALLOW THEIR LEARNERS TO PARTICIPATE

LETTER REQUESTING PARENTAL CONSENT FOR MINORS TO PARTICIPATE IN A RESEARCH PROJECT

Dear Parent

Your child is invited to participate in a study entitled the role of play in teaching number sense to Grade 3 learners.

I am undertaking this study as part of my master's research at the University of South Africa. The purpose of the study is to explore the role of play in teaching number sense to Grade 3 learners and the possible benefits of the study are the improvement of Mathematics. I am asking permission to include your child in this to collect data from his/her classwork books and workbooks from the activities given by his/her educator. I expect to have your child and other children participating in the study.

If you allow your child to participate, I shall request him/her to:

- Take part in a document analysis where the researcher will ask your child's educator to send your child's work from classwork books and workbooks through e-mail.

Any information that is obtained in connection with this study and can be identified with your child will remain confidential and will only be disclosed with your permission. His/her work will not be linked to his/her name or your name or the school's name in any written or verbal report based on this study. Such a report will be used for research purposes only.

There are no foreseeable risks to your child by participating in the study. Your child will receive no direct benefit from participating in the study; however, the possible benefits to education are educators understanding how play can be used to teach Mathematics in the Foundation Phase. Neither your child nor you will receive any type of payment for participating in this study.

Your child's participation in this study is voluntary. Your child may decline to participate or withdraw from participation at any time. Withdrawal or refusal to participate will not affect him/her in any way. Similarly, you can agree to allow your child to be in the study now and change your mind later without any penalty.

The study will take place during regular classroom activities with the prior approval of the school and your child's teacher. However, if you do not want your child to participate, there is no other alternative activity will be available.

In addition to your permission, your child must agree to participate in the study and you and your child will also be asked to sign the assent form which accompanies this letter. If your child does not wish to participate in the study, he or she will not be included and there will be no penalty. The information gathered from the study and your child's participation in the study will be stored securely on a password-locked computer in my locked office for five years after the study. Thereafter, records will be erased.

The benefits of this study are educators understanding how play can be used to teach Mathematics in the Foundation Phase.

There are no potential risks

There will be no reimbursement or any incentives for participation in the research.

If you have questions about this study please ask me or my study supervisor, Dr RSS Mphahlele, Department of Early Childhood Education, College of Education, University of South Africa. My contact number is 0826495911/0672762321 and my e-mail is mmakgaboangelinah@gmail.com. The e-mail of my supervisor is Emphars@unisa.ac.za. Permission for the study has already been given by your principal and the Ethics Committee of the College of Education, UNISA.

You are deciding to allow your child to participate in this study. Your signature below indicates that you have read the information provided above and have decided to allow him or her to participate in the study. You may keep a copy of this letter.

Sincerely

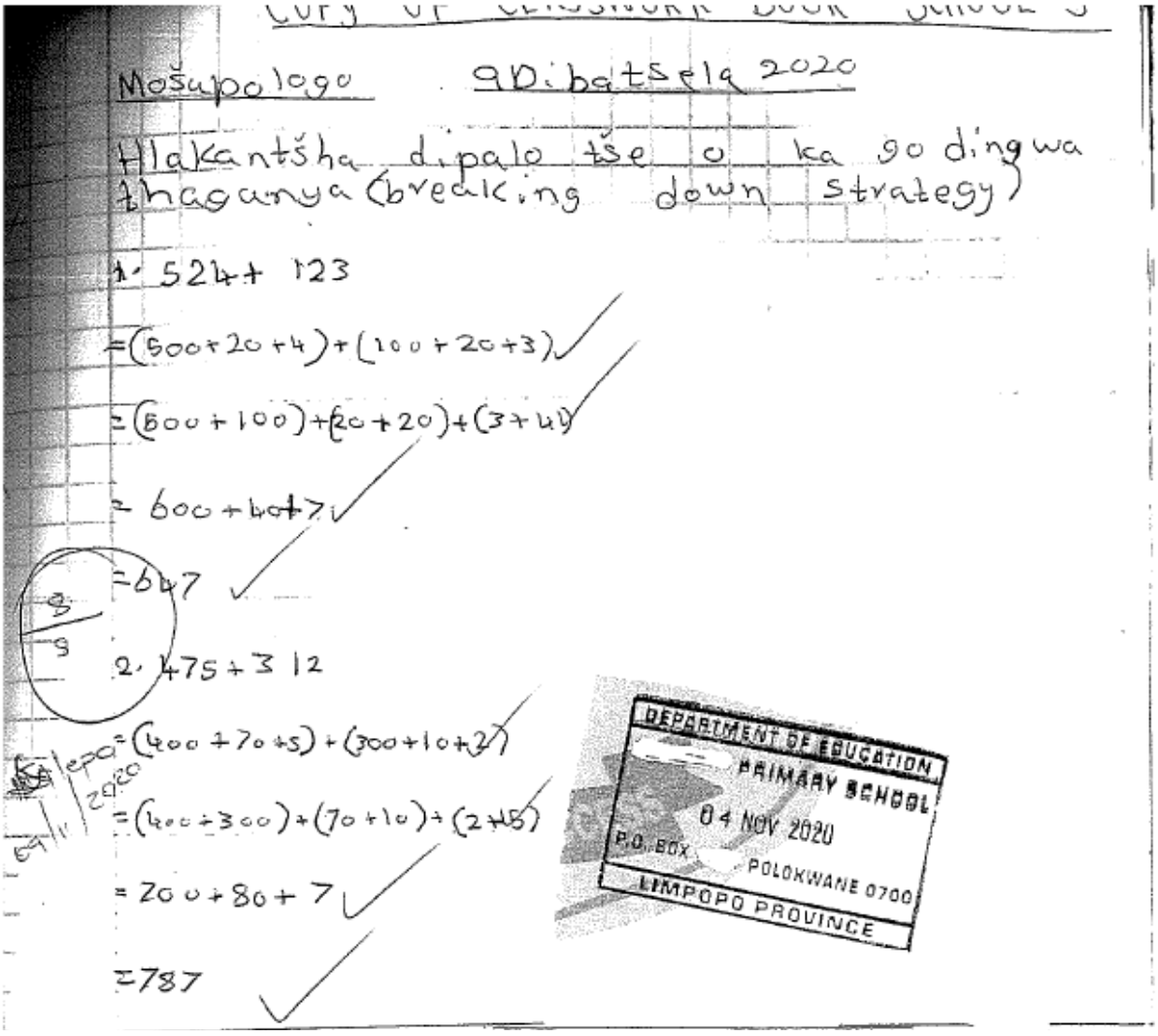
_____ _____

Parent/guardian's signature: Date:

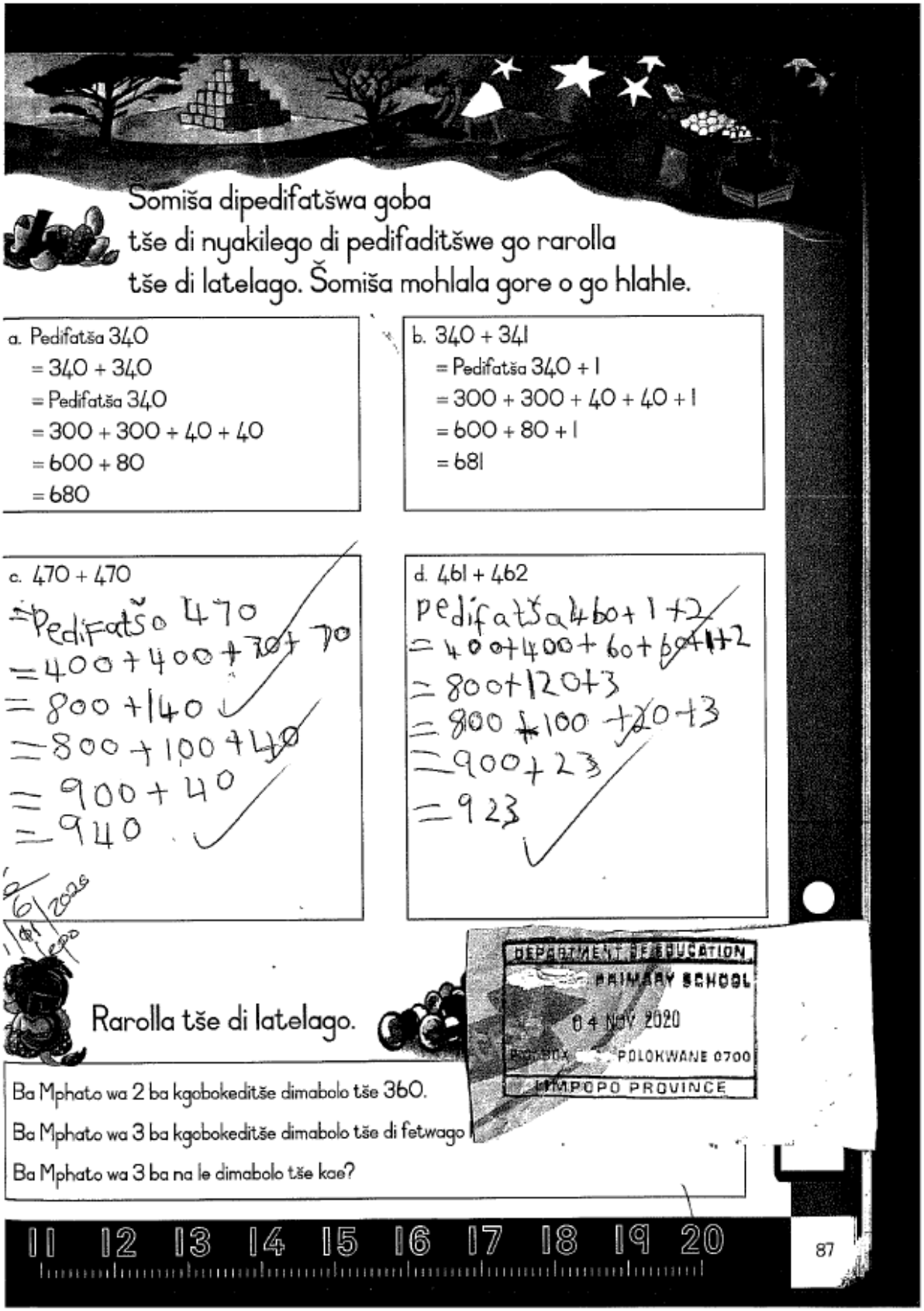
Mmakgabo Angelinah Selepe _____ _____

Researcher's name (print) Researcher's signature Date:

APPENDIX T: SAMPLE OF LEARNERS CLASSWORK BOOK: S3E4



APPENDIX U: SAMPLE OF LEARNERS WORKBOOK: S3E4



Somiša dipedifatšwa goba
tše di nyakilego di pedifaditšwe go rarolla
tše di latelago. Somiša mohlala gore o go hlahle.

a. Pedifatša 340
= 340 + 340
= Pedifatša 340
= 300 + 300 + 40 + 40
= 600 + 80
= 680

b. 340 + 341
= Pedifatša 340 + 1
= 300 + 300 + 40 + 40 + 1
= 600 + 80 + 1
= 681

c. 470 + 470
=Pedifatšo 470
=400+400+70+70
=800+140
=800+100+40
=900+40
=940

d. 461 + 462
pedifatša 460+1+2
=400+400+60+60+1+2
=800+120+3
=800+100+20+3
=900+23
=923

6/11/2020

Rarolla tše di latelago.

Ba Mphato wa 2 ba kgobokeditše dimabolo tše 360.
Ba Mphato wa 3 ba kgobokeditše dimabolo tše di fetwago
Ba Mphato wa 3 ba na le dimabolo tše kae?

DEPARTMENT OF EDUCATION
PRIMARY SCHOOL
04 NOV 2020
POLOKWANE 0700
LIMPOPO PROVINCE

11 12 13 14 15 16 17 18 19 20

87

APPENDIX V: SAMPLE OF LESSON PLAN: S2E3

S2E3 LESSON PLAN 1

Primary School

Grade : 3
Subject : Mathematics
Content area : Numbers, operations and relationships
Topic : Counting in 10's forwards and backwards
Mental Maths
Comparing numbers from 701 upto 800

Aims and objectives

- Learners should be able to count in 10's from 710-800
- Learners should be able to compare and order numbers upto 800

Lesson presentation

Teacher's activities	Learners 'activities
INTRODUCTION	
The teacher will ask the learners to take out their number grids and count in 10's from 710 to 800 and from 715 to 785	Learners will count in 10's from 710 to 800 and from 715 to 785 using their number grids
The teacher will ask learners to give numbers between the two given as their mental maths activity 753 and 755 120 and 122 445 and 447	Learners will give numbers between the two given as their mental maths activity 754 121 446
LESSON CONTENT	
The teacher will ask learners to give five numbers that are bigger than 710 but less than 718	Learners will give any numbers that are bigger than 710 but less than 718 Eg:- 711, 712, 713, 714, 715,716,717
The teacher will ask the learners to arrange numbers from smallest to biggest 710, 770, 777, 701, 717 = 701,710,717,770, 777	The learners will arrange numbers from smallest to biggest 710, 770, 777, 701, 717

The teacher will ask the learners to arrange numbers from the biggest to smallest 710, 770, 777, 701, 717 = 777, 770, 717, 710, 701	The learners will arrange numbers from the biggest to smallest 710, 770, 777, 701, 717

Classwork

1. Write down five numbers that are bigger than 722 but less than 729.
2. Arrange these numbers from smallest to biggest.
   710, 770, 701, 777, 717
   (701, 710, 717, 770, 777)
3. Arrange these numbers fro biggest to smallest.
   710, 770, 701, 777, 717
   (777, 770, 717, 710, 701)
4. Write the following numbers in words:
   a) 715 = Seven hundred and fifteen
   b) 731 = Seven hundred and thirty-one

Homework

Leaners will do activity on page 70& 71 DBE workbook

Conclusion

The teacher will control learners' workbooks and give feedback for the classwork.

APPENDIX W: PICTURES OF EDUCATORS AND LEARNERS PLAYING GAMES TO TEACH NUMBER SENSE

Classroom 4 (learners playing skipping rope while breaking number sense)

Classroom 6 (S3E6 demonstrating to learners how to play the game Diketo)

APPENDIX Y: TURNITIN CONFIRMATION REPORT

Turnitin Originality Report

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Dissertation revision 1 By Selepe Mmakgabo Angelina

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EXPLORING THE ROLE OF PLAY IN TEACHING NUMBER SENSE TO GRADE 3 LEARNERS by MMAKGABO ANGELINAH SELEPE submitted in accordance with the requirements for the degree of MASTER OF EDUCATION in PSYCHOLOGY OF EDUCATION in the COLLEGE OF EDUCATION at the UNIVERSITY OF SOUTH AFRICA SUPERVISOR: DR RSS MPHAHLELE 2021 DECLARATION NAME: MMAKGABO ANGELINAH SELEPE STUDENT NUMBER: 64019209 DEGREE: MASTER OF EDUCATION IN PSYCHOLOGY OF EDUCATION TITLE: EXPLORING THE ROLE OF PLAY IN TEACHING OF NUMBER SENSE TO GRADE 3 LEARNERS. I Mmakgabo Angelinah Selepe, declare that this dissertation is my original work. It has not been presented at any university and all the sources used or quoted have been indicated and acknowledged employing complete references. I further declare that I submitted the dissertation to originality checking software and that it falls within the accepted requirements for originality. Signature: Date: 15 June 2021 i ACKNOWLEDGEMENTS Firstly, I would love to thank God for the precious life he has given me and for giving me the wisdom to complete this project on "Exploring the role of play in teaching number sense to Grade 3 learners". I would also like to appreciate the effort put forward by supporting towards completion of this study: To my supervisor, Dr R. S.S Mphahlele, I would love to thank you for all your academic

APPENDIX Z: EDITING REPORT

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24 July 2021

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EXPLORING THE ROLE OF PLAY IN TEACHING NUMBER SENSE TO GRADE 3 LEARNERS

by

MMAKGABO ANGELINAH SELEPE

I declare that I have edited and proofread this thesis. My involvement was restricted to language usage and spelling, completeness and consistency and referencing style. I did no structural re-writing of the content.

I am qualified to have done such editing, being in possession of a Bachelor's degree with a major in English, having taught English to matriculation, and having a Certificate in Copy Editing from the University of Cape Town. I have edited more than 200 Masters and Doctoral theses, as well as articles, books and reports.

As the copy editor, I am not responsible for detecting, or removing, passages in the document that closely resemble other texts and could thus be viewed as plagiarism. I am not accountable for any changes made to this document by the author or any other party subsequent to the date of this declaration.

Sincerely,

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