PHENOMENOLOGICAL STUDY OF PRACTITIONERS' LIVED MATHEMATICAL PLAY PRACTICES IN AN EARLY CHILDHOOD CARE AND EDUCATION SETTING

By

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DECLARATION

I, Seipati Baloyi-Mothibeli, declare that the contents of this thesis represent my own work and that the thesis has not previously been submitted for academic examination towards any qualification. All sources used or cited have been fully acknowledged and referenced. It is being submitted for the degree of Doctor of Philosophy at the University of the Free State. It has not been submitted elsewhere in any format for a degree or examination at any other university.

8 June 2022

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Seipati Lydia Baloyi-Mothibeli Date

DEDICATION

I dedicate this thesis to my one and only daughter Keamohetsoe Kamo Mothibeli, to serve as a motivation and encouragement to her. I also dedicate the thesis to my mom Alice Gladys Malerato Baloyi, who has been waiting patiently for me to complete this journey and take care of her. To my sister Dr. Motlalepule Patience Baloyi, and my brother Lebogang Brian Baloyi, you have been my inspiration and driving force behind this journey. To Blondie Mekgwe, you have been a pillar of strength throughout this journey my sister and thank you for your support. To all my relatives and friends, your prayers and words of encouragement contributed to who I am today. It was not easy, but it's worth it.

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ABSTRACT

Globally, research indicates growing interest in mathematics-related play in early childhood settings; this is also the case in the informal settlements of Mangaung in the Motheo District. This interest has its roots in the poor performance of learners in mathematics when they reach formal education, particularly in the foundation phase. The aim of this study was to carry out a phenomenological investigation of practitioners' lived mathematics play practices in early childhood care and education settings. The study is located in Vygotsky's social constructivist theory, which maintains that children acquire knowledge best if there is scaffolding and mediation by more knowledgeable others. Vygotsky defined the more knowledgeable other as someone who has a better understanding or higher ability levels than the child on a particular task, process, or concept. Therefore, language and environment play a major role in the child's process of new knowledge creation. Vygotsky believed that knowledge is first acquired interpersonally, as the child learns from others, then internalises knowledge; the process takes place in the zone of proximal development (ZPD). Vygotsky explains ZPD as the distance between what children can do by themselves, and what they can achieve with competent assistance by more knowledgeable others. Additionally, the study employed an interpretive qualitative research paradigm and a phenomenology design. Data was collected through semi-structured interviews, observations and journal entries by the researcher. A purposeful sample of 10 practitioners who were teaching in five early childhood care and education setting took part in the study. Data generated were analysed through the lens of Vygotsky's sociocultural theory and a thematic approach, through which subthemes emerged. The finding of this study is that practitioners' lived mathematics play practices in ECCE settings were compromised, as they are not adequately qualified in this context. It is concluded that, through proper teacher development programmes and obtaining adequate qualifications, practitioners' lived mathematics play-based learning can be enhanced. Therefore, it is recommended that local higher education institutions design and offer a qualification that is adequate for ECCE practitioners, and which incorporates curriculum content that is supposed to be taught to children in this environment to enhance mathematics play-based learning.

Keywords: Early childhood care and education, early childhood development, mathematical play, mathematics, phenomenology, practitioner

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LIST OF ACRONYMS AND ABBREVIATIONS

CAPS	Curriculum Assessment Policy Statement
CBC	Community-based centre
DHET	Department of Higher Education and Training
DoE	Department of Education
DSD	Department of Social Development
ECCE	Early childhood care and education
ECD	Early childhood development
ECE	Early childhood education
ECEC	Early childhood education and care
NCF	National Curriculum Framework
NDA	National Development Agency
NGO	Non-governmental organisation
NQF	National Qualifications Framework
PIECCE	Project for Inclusive Early Childhood Care and Education
TVET	Technical and Vocational Education and Training
Unisa	University of South Africa
ZPD	Zone of proximal development

CHAPTER 1

INTRODUCTION AND BACKGROUND TO THE STUDY

1.1 INTRODUCTION

Over the 30 years I have been involved in in early childhood care and education (ECCE), there has been increasing attention paid to the quality of teaching and learning of young children. This increasing concern relates to the need for practitioners who are able to comprehend what is happening in the ECCE setting, and who are knowledgeable about how to engage children in early mathematics-related play through innovative approaches that are compatible with the ECCE setting (Svensson, 2015:2). Young children find mathematical play noisy, messy, fun and interesting and, at the same time, it inspires growth and intellectual development in language, literacy, logic and mathematics in the ECCE setting (Trundle & Smith, 2017:81). To enhance these skills in children, practitioners should create opportunities for children to explore and practise mathematical play, as children spend a large amount of time in ECCE centres, which become the social environment where learning takes place (Sotuku, Okeke & Mathwasa, 2016:25). These opportunities are rarely provided to young children in South Africa, as ECCE practitioners often neglect them and offer only what feels comfortable in the ECCE setting (Helmbold, 2014:3). Ashley-Cooper, Niekerk and Atmore (2019:88) added by saying that there is no equitable access to ECD provisioning of ECD in South Africa. My experience has taught me that high quality teaching and learning in mathematics occurs through play, and that play creates more opportunities for young children to learn and quality access in the ECCE setting

Although play is an important vehicle for promoting teaching and learning in the early years, particularly in ECCE mathematics, it would appear that practitioners are not emphasising and practicing it enough. Practitioners are often not aware that play can support both academic and social learning, and what their own roles can be in children's play (Vu, Han & Buell, 2015:443). Considering the South African context, it has a long way to go to improve the quality of teaching and learning in the ECCE setting. Practitioners still struggle to conceptualise the ECCE setting and understand mathematical play programmes to which children need to be exposed. In the

background to the study, which will follow next, I draw from existing international and local literature to establish the rationale for the present study, which culminated in this thesis.

1.2 BACKGROUND TO THE STUDY

The ECCE setting may mean the same or different things in different countries and in different settings. Research worldwide is concerned about what happens in ECCE. For instance, in Australia, early childhood education and care (ECEC) involves programmes for children for a year before they start school (O'Connor et al., 2020:93). In Canada, the early childhood care and development programme is a strategy to ensure and a component of the action to develop the potential of children below the age of five years (Nilsen & Steen-Johnsen, 2020:2). According to Nyamukapa (2016:2), in Zimbabwe, the ECCE programme relates to a set of efforts to ensure child survival, health, nutrition, school readiness and support for learning, from conception to age eight. In Nigeria, the early childhood education (ECE) programme denotes the informal, traditional upbringing given from infancy through to three years old, to ensure school readiness (Obiweluozor, 2015:2). In Botswana, the ECEC programme is defined as a programme to meet the needs of young children from birth to age six (Mpuang, Mukhopadhyay & Malatsi, 2015:68).

In the South African context, early childhood development (ECD) is an umbrella term that refers to all the services that promote or support the development of young children from birth to nine years (DSD, 2015:11). These services include infrastructure, health, security and learning programmes that prepare children for formal teaching and learning in the ECCE setting (Meier, Lemmer & Niron, 2015:445). ECD programmes that are intended to develop educators who are able to support and promote early learning and development for babies, toddlers and young children (DHET, 2017:8). These are programmes for pre-Grade R, currently known as the ECCE programme. This is a term chosen as a qualifier to name some of the qualifications in this Policy that are intended to develop educators who are able to support and promote early learning and development for babies, toddlers and young children (DHET,2017:8).

This is one of the aspects of ECD that provides care and developmentally appropriate education and stimulation for young children from conception until the year before they enter Grade R (DSD, 2015:11). This imply that all the children that from four years and below are catered in the ECC, which take place before Grade R, which is responsible for the provisioning of school readiness for four-and-a-half to five-year-old children before they start formal schooling. Lastly, the foundation phase delivers formal teaching and learning for children from six to nine years old; this involves Grades 1 to 3.

Given the different definitions of ECCE in different countries and how it has been adopted in South Africa – as demonstrated in Figure 1.1, I adopted the conceptualisation of the ECCE programme provided by the Department of Higher Education and Training (DHET). According to the DHET, the ECCE programme signifies the support and promotion of early learning and development for babies, toddlers and young children from birth to age four (DHET, 2017:23). This means that no child will be left behind on issues of learning readiness, developmental appropriateness and instructional reform in the early years (Repko-Erwin, 2017:58).

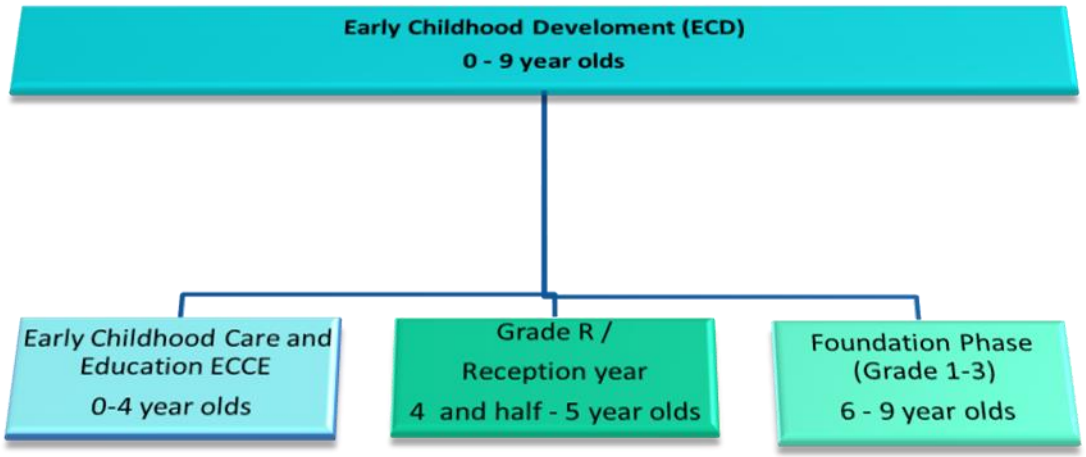


Figure 1.1: The structure of ECD in South Africa

ECCE mathematics education requires a distinctive and child-friendly approach. Studies have shown that there are certain characteristics associated with ECCE mathematics education. For instance, Beke (2017:187) asserts that, through mathematics education, children begin to know the world around them and realise it through concrete actions, interaction with others and problem-solving. In addition, mathematics education in early childhood has long-term positive effects on future

academic success and access to the labour market for children at a later stage (Lebihan & Moa Takongmo, 2018:2). Furthermore, a solid foundation for mathematics literacy fosters young children emotionally, socially, intellectually, physically, spiritually and morally (Nel, 2019:4). Palmér, Henriksson and Hussein (2016:79) argue that young children demonstrate a remarkable ability to formulate, represent, and solve simple mathematics problems, and to reason and explain their mathematics activities in their first mathematics encounter. According to Moss, Bruce and Bobis (2016:157), mathematics education builds prior knowledge in the child, though this alone was not enough to develop mathematical thinking – the child also needs guidance from an adult. Askew and Venkat (2020:2) are of the opinion that one of the aims of mathematics education is to provide children with the skill of being fluent in early counting, as well as developing an appreciation of numerosity.

Given these distinctive attributes of mathematics education in the ECCE setting, practitioners must follow a unique approach, which revolves around how children learn in the ECCE setting. The approach to leaning mathematics should be based on the principle of integration and play-based learning. Practitioners should discover and adapt their practices according to this approach (DBE, 2011:14). Practitioners play a major role in advocating for appropriate practices to stimulate mathematical concepts, among these practices are purposeful play, child-directed play, scaffolding and mediation that follow children's intuition in the ECCE setting (Feza, 2016:484).

Researchers are not unanimous about the exact nature of play in the ECCE setting, and what practitioners mean by a play-based approach. This is an area of debate and differing interpretations and it may mean different things in different cultural contexts (Excell & Linington, 2015:190). For example, in Australia, play is defined as an opportunity for children to learn, discover, create, improvise, imagine and socialise with the group (DEEWR, 2009:15). Moreover, play empowers young children to develop skills, critical thinking, creativity, and collaboration, with the help of adults and peers. During this time, they construct knowledge about events, the environment, and people (Aronstam & Braund, 2015:1). A study in Nigeria by Popoola (2014:320) describes play as an activity that develops the child's cognitive, social, and emotional skills, to assist the child to gain self-confidence and engage in new experiences. According to Bose and Seetso (2016:2), in Botswana, play is described as a basic

activity for teaching and learning. It provides children with opportunities to be creative, to build abstract thinking and to interact with one another.

In the South African context, play is regarded as a right of children, and allows a child to rest, to have leisure, to play, and participate in recreational activities appropriate for their ages, and to engage freely in cultural life and the arts (Abrahams & Matthews, 2011:23). This means that anybody participating in the care, growth and protection of children has to abide by the legal framework provided by the mandatory documents (Sotuku et al., 2016:26). These mandatory documents are NCF (DSD, 2015), DHET (2017), Policy on Minimum Requirements for Programmes Leading to Qualifications in Higher Education for Early Childhood Development Educators and DSD 2015 Department of Social Development, 2015. National integrated early childhood development policy. It is important that ECCE practitioners include different styles of play in their teaching and learning. Therefore, they should be aware of different styles of play to which children should be exposed, for example, child-directed, mutually directed, and teacher-directed play (Pyle & Danniels, 2017:274).

Having highlighted what we now know about play, mathematical play can be defined an as independent activity with a playful orientation that is engaged in by people of all ages (Williams-Pierce, Plaxco, Reimer, Ellis & Dogan, 2018:1508).

Research has found that mathematical play practices can be important in teaching and learning in the ECCE setting (Vu et al., 2015:443). For instance, in Australia, play-based mathematics activities are tailored to support children's overall mathematical ideas, skills and reasoning (Wickstrom, Pyle & DeLuca, 2019:288). The literature reveals that mathematical play should be customised to reinforce children's current knowledge of future problem-solving (Özdoğan, 2011:319). The playful engagement with mathematics enhances children exploration of structures and systems that are driven by curiosity, imagination, expands creativity in all aspects of mathematical play (Lee, Wongkamalasai, Thompson, Jasien & Rubin, 2020:1495).

This study identified three types of mathematical play, namely mathematically embedded play; play centring on mathematics; and practitioners' guided play. Taylor and Boyer (2020:128) report that children who attended developmentally appropriate play-based programmes gained more mathematical play knowledge than children who did not participate in the play-based programmes. In South Africa, the Curriculum and

Assessment Policy Statement (CAPS) defines play as a natural way of learning that involves different stages: the kinaesthetic stage, the concrete stage and the semi-concrete stage, that must be presented in a daily programme in the ECCE classroom (DBE, 2011:14). We need to understand the importance of play and the types of play practices that can encourage practitioners to engage and assist children to learn and understand mathematics play in teaching and learning in the ECCE setting.

Research has shown that, while the role of educators in supporting and guiding children through play is emphasised, there is tension, born out of educators' beliefs, experiences, knowledge and attitudes about mathematical play within the ECCE context (Breathnach, 2017:5). These attributes of some teachers can either enhance or impede the use of play practices. Educators believe that involving play in teaching and learning enhances children's academic skills, and their social-emotional development (Vu et al., 2015:444). A study by Adhikari (2019:32) indicates that teachers' level of teaching experience influences students' achievement; meaning that less experienced teachers produce lower achievement in their students than experienced teachers. Jensen, Pyle, Alaca and Fesseha (2019:5) argue that teachers lack the in-depth knowledge they need to implement guided play and cannot predict the material that the children will integrate into their play during teaching and learning. Stemmert (2019:27) affirms that integrating play in teaching and learning influences children holistically and spiritually, thus, making them feel safe in the ECCE setting. In order to achieve this, Erasmus (2019:15) emphasises that special knowledge of ECCE is required and essential for professional practice.

There are common practices that teachers follow when engaging children in play-based mathematics learning in ECCE settings (Pyle, Prioletta & Poliszczuk, 2018:223). Ryan and Tilbury (2013:272) define practice as teaching and learning experiences that learners are exposed to in different situations within and outside the classroom setting. One of the roles of practitioners in teaching and learning is to create an atmosphere that fosters mathematical thinking, and an understanding of children's needs (Kaya & Aydın, 2014:1621). Research by Sandseter and Sando (2016:2) found that most of children's mathematical play-learning practices are strictly regulated by practitioners. It means that practitioners generally decide what children are allowed to do and where they are allowed to go; no child initiates play. Cohrssen, Church and Tayler (2016:9) posit that the goal of practitioners' mathematics education is to

implement play-based activities that provide children with optimal opportunities to explore their environment, learn, socialise with peers, and evolve in cooperative play. In addition, Baloyi-Mothibeli (2018:10) argues that children learn mathematics through three stages: concrete stage; pictorial stage; and the abstract representation stage, which practitioners should include and expose the children to in their teaching and learning in the ECCE context. Young children perform well when they are engaged by well-trained and adequately qualified practitioners who have knowledge of how to integrate mathematics and play both socially and academically, for the long term. According to Organisation for Economic Co-operation and Development [OECD], (2011:5), understanding mathematics practices that are particular to the ECCE setting is important; therefore, it is necessary to establish what practitioners' practice involves and how they implement these practices in this context.

Despite the existence of policies and legislation to improve teaching and learning in the ECCE sector, there are challenges that impede practitioners from implementing mathematical play effectively. According to Sandseter and Sando (2016:10), practitioners limit children's outdoor play because of the absence of outdoor equipment and the danger posed by surfaces that lack shock-absorbing qualities. Vorster, Sacks, Amod, Seabi and Kern (2016:1) indicate that teachers are not appropriately trained and do not possess the skills necessary to implement the recommended curriculum. Bose (2008:80) reports that there is a shortage of adequate training centres for preparing ECED teachers; furthermore, teachers face academic insecurity; language barriers; a lack of institutions to capacitate ECCE practitioners and an inability to pay for coursework to improve their qualifications. In the South African context, Ebrahim (2014:70) states that,

> *Fragmentary field, lack of a unified vision and capacity, reluctance to move out of the comfort zone of existing practice are some challenges faced by practitioners. Additionally, absence of a critical mass, inadequately qualified practitioners, poorly trained and high illiteracy rates among many practitioners and primary caregivers still dominate the field of ECD.*

However, Richter and Samuels (2018:18) report that teaching and learning vary in the way that ECCE practitioners are implementing mathematical play-based learning and that the teacher/learner ratio has not been adequately addressed. Some practitioners have more than 50 learners in classes, instead of a teacher/learner ratio of 30:1, which

is the norm in the ECCE setting and also recommended as articulated in the policy guideline (DBE: 2011:4).

. These factors affect the classroom capacity and play area, and limits the resources available to children.

Research recommends that practitioners should be assisted to use effective strategies when working with children in ECCE. For example, Taylor and Boyer (2020:124) and Wadsworth (2014:10) report that, regardless of the challenges facing the ECCE sector, underqualified practitioners' education level has been improved through training; they receive more teaching support, which enables them provide care that is on par with that of teachers possessing Bachelor's degrees. Ramani, Rowe, Eason and Leech (2015:17) report that the majority of young children develop a sound mathematics foundation with the support of practitioners and parents. Encouraging parental development assists practitioners to engage children in mathematical play. Furthermore, the National Integrated Early Childhood Development Policy encourages practitioners to give children opportunities to learn through play in order to promote and acquire mathematical skills; play can also reduce inequality and improve educational opportunities and access for all children (DSD, 2015:7).

Mathematical play practices have implications for the teaching and learning of mathematics in the preschool context.

Studies have shown that there is a rural aspect to ECCE provisioning. For instance, a study conducted by Sotuku et al. (2016: 25) indicates that the number of young children accessing ECCE services in rural areas is increasing rapidly, which necessitates researchers to pay more attention to how ECCE is provisioned in rural settings. Research suggests that education in many rural areas are affected by multiple issues and continue to face substantial challenges (Mabaso, 2017:12). These challenges include lack of educational tools and facilities, lack of adequately qualified teachers and high teacher–learner ratios, and a shortage of early childhood services, which results in most learners being academically disadvantaged (Mabaso, 2017:47). Furthermore, research by Hannaway, Govender, Marais and Meier (2018:2) found that there is disparity between rural and urban education, particularly regarding ECCE. Other literature calls for rural education receiving the same treatment as urban education, to achieve equality status for the two geographical areas (Mpahla & Okeke,

2015:25). Given that the current study has a focus on both rural and urban education, I question whether practitioners' mathematical play practices may be impacted by the demographic phenomenon of location. It is, therefore, appropriate for the present study to explore factors that may impact practitioners' mathematical play practices in the rural context.

The importance of play in the teaching and learning of mathematics has attracted significant attention from education researchers the world over. Nevertheless, it appears that little work has been done by South African researchers on the impact of mathematical play on ECCE provisioning. Research is scarce on this topic in South Africa, and research on mathematical play is concentrated on urban areas – rural areas have received little attention. This means existing research benefits mainly children in urban areas, thus, widening the gap between advantaged and disadvantaged groups of children (Richter & Samuels, 2018:17). Furthermore, the bulk of attention has been given to ECCE settings that are attached to schools (those that are subsidised by the Department of Social Development (DSD). By undertaking this study, the researcher's intention was to generate evidence of what practitioners do and how they engage children in mathematical play. Proper implementation of play-based learning in this study will implicate policymakers and curriculum developers in the ECCE area.

1.3 PROBLEM STATEMENT

Research shows that, in the South African education system, there is growing interest in mathematics play in the ECCE setting. This interest in early mathematics learning has its roots in the declining performance of learners in mathematics in higher grades (Wickstrom et al., 2019:287). The impact of play on children's learning and development, and the overall importance of play, is emphasised all over the world (Weisberg, Hirsh-Pasek, Golinkoff, Kittredge & Klahr, 2016:177). Research has shown that it is important for their future achievement for children to start acquiring mathematics knowledge before formal education starts; it also helps them to cope with the teaching and learning in the ECCE platform. South African policies on ECD, such as the CAPS for Grade R, and the National Curriculum Framework (NCF) for children from birth to four years, emphasise the importance of play and how it impacts on the teaching and learning of mathematics play (DBE, 2011:14; RSA DBE, 2015:7). A study

by Tonge, Jones and Okely (2019:31) shows that practitioners have a significant role to play in ECCE, to facilitate and provide opportunities for engaging in interaction with young children in mathematical play. In South Africa, this has been not always the case, as many practitioners in the ECCE setting teach young children using the demonstration method, which excludes children's mathematical play activities (Popoola, 2014:322). Against this background, there is little empirical evidence to show how practitioners support mathematical play in the early childhood years (Adhikari, 2015:12). In this study, the researcher's intention was to generate empirical evidence of what practitioners do and how they effectively engage children in mathematical play.

1.4 RATIONALE FOR THE STUDY

While most researchers describe play as an important pedagogy for improving mathematical play in the ECCE setting, the shortage of well-trained practitioners remains the main challenge, and it impacts negatively on the teaching and learning of children. In addition, practitioners' competencies and professional development, as well as knowledge on how to integrate play in the teaching of mathematics for young children, are major concerns. In the reviewed literature, the researcher observed that the amount of time that young children spend on play and being exposed to mathematical play is of great importance. Regrettably, this aspect does not always receive the attention it deserves, and this neglect affects the quality of teaching and learning in the ECCE setting negatively. Mathematical play activities that are developmentally appropriate should be carefully planned. Practitioners should know what exactly is expected of them and how they can engage children at various ages and stages of development in mathematical play. Currently, effective plans to support practitioners and enhance their knowledge on how to integrate play and mathematics in the ECCE learning are not in place. Furthermore, there is little empirical evidence on how practitioners are supporting mathematical play in the early years. It is evident from the literature that the current education system for the ECCE setting requires practitioners to be conversant with current trends in education, education legislation and education polices. Thus, the researcher intended to establish practitioners' lived mathematical play practices in ECCE settings.

1.5 AIM OF THE STUDY

The aim of the study was to carry out a phenomenological study of practitioners' lived mathematical play practices in ECCE settings.

1.5.1 Specific objectives

The specific objectives of the study were to

1. Explore current practitioners' lived mathematical play practices in the ECCE setting;
2. Analyse how ECCE practitioners prepare the mathematical play environment in community-based centres;
3. Examine challenges faced in ensuring a proper environment for mathematical play practices;
4. Explore factors that may impact practitioners' mathematical play practices in a rural context; and
5. Establish measures to ensure a proper environment for mathematical play practices.

1.6 MAIN RESEARCH QUESTION

The main research question for the study is as follows:

What are practitioners lived mathematical play practices in early childhood care and education settings?

1.6.1 Research sub-questions

In order to answer the main question, the sub-questions below were addressed:

1. What are the current lived mathematical play practice of practitioners in the ECCE setting?
2. How do ECCE practitioners prepare the mathematical play environment in community-based centres?
3. What are the challenges faced in ensuring the proper mathematical play practices environment?
4. What are the factors that may impact on practitioners' mathematical play practices in a rural context?
5. What are the measures to ensure a proper mathematical play practices environment?

1.7 DELIMITATION OF THE STUDY

The study involved ECCE practitioners in the Motheo District of the Free State province of South Africa. Their participation assisted the researcher to understood what was happening in ECCE in Motheo District, and how practitioners understand their practices relating to teaching and learning through mathematical play in the ECCE setting.

1.8 SIGNIFICANCE OF THE STUDY

The integration of play in teaching and learning in the ECCE setting is an important issue in mathematics, as this discipline is one of the important early learning and development areas (DBE, 2015:8). It is important to indicate that this study will contribute and be valuable in the following ways:

- It will promote the development of mathematical play by children, and their knowledge and skills related to learning through play in the ECCE setting.
- This study will contribute to the teaching and learning of mathematical play, to the way practitioners can incorporate different types and stages of play, and the provisioning of opportunities for children to learn in the ECCE setting.

- Parents will also benefit, as they will know how their children learn through play and how they can enhance the acquisition of mathematics through play at home.
- This research may be a revelation to policymakers and curriculum planners, and provincial officials delegated to working with young children in the ECCE setting.
- The study findings may be valuable to other researchers in this field, and prospective and incoming university student teachers in the area of childhood learning.
- Other stakeholders, such as policymakers, curriculum developers, curriculum designers, education district and provincial office officials, and representatives of ECCE practitioners will be involved in contributing to effective planning and implementation of programmes to enrich mathematical play in the ECCE sector.

1.9 DEFINITION OF OPERATIONAL CONCEPTS

This section will present definitions of the operational concepts that will be used throughout the study. These definitions will present different perspectives, and were sourced from books, policies and a literature review of recent articles. These concepts include the following.

Phenomenology

Phenomenology is described as research that is focused on a sober reflection of the lived experiences relating to human existence. It is an approach that advocates for freedom from theoretical, prejudicial and suppositional blindness (Nieuwenhuis, 2020:95). In the context of the study, phenomenology, I observed activities as they occurred in the ECCE setting.

Practitioner

A person or staff member who provides ECD services through formal ECD programmes, family services, playgroups and training (DSD, 2015:12). In the context of the study, practitioners are females who is taking responsibility of development and learning of young children in early years from birth to four years in the ECCE setting.

Play

Play is defined as an opportunity for children to learn, discover, create, improvise, imagine and socialise with the group (DEEWR, 2009:15). Furthermore, Svensson (2015:2004) and Robertson (2016:72) describe play as an important means of learning in the early years. It is fun, promotes interaction between practitioner and children and within children themselves, thus, encompasses a diverse range of activities. In line with context of the study, play is viewed as a right of children, and they learn easily when engaging in play based mathematical play and play-based learning.

Mathematics

Mathematics is a language that makes use of symbols and notations for describing numerical, geometric and graphical relationships. It helps to develop mental processes that enhance logical and critical thinking, accuracy and problem-solving that will contribute to decision-making (DBE, 2011:8). For the purpose of the study mathematics is seen as a subject that help the children to socialise, communicate and learn from one another while engaging in their daily activities in the ECCE setting and at home when guided by parents.

Mathematical play

Mathematical play is a process used to solve mathematical problems, which involves both experimentation and creativity to generate ideas, and uses the formal rules of mathematics to follow any ideas to some sort of conclusion. Mathematical play is designed to allow complete freedom on the part of the solver to wander over the mathematics landscape (De Holton, Ahmed, Williams & Hill, 2001:103). In line with the study, mathematical play was used as a strategy to enhance awareness of mathematical skills that are embedded in play.

Practices

According to Ryan and Tilbury (2013:272), practices refer to teaching and learning experiences that learners are exposed to in different situations within and outside the classroom setting, through application and action. For the purpose of the study practice allowed children to observe, touch the manipulatives and share best practice and daily problem solving.

Early childhood care and education

ECCE is one of the components of ECD, and provides daily care, education and stimulation for the emotional, cognitive, sensory, spiritual, moral, and physical, and social and communication development of infants and young children (DHET, 2016:6). Within the context of the study, ECCE is aiming at developing children in totality in with specific reference to mathematical play-based learning.

Early childhood development

ECD refers to a comprehensive approach to policies and programmes for children from birth to nine years of age, which involves the active participation of their parents and caregivers (DSD, 215:11). This term encompasses the programmes that cater for children from birth to nine years old, for the purpose of the study I will only forces on children from three to years old in the ECCE setting.

Child

A child refers to all babies, toddlers and young children, whatever their abilities, gender, background, language or culture (DBE, 2015: ii). In line with the context of study, I will adopt the definition of the DSD (2015) with reference young children. This Policy assumes age at the child's last birthday. For example, reference to children from birth to four, means all children who have not yet turned 5 (DSD,2015:11).

1.10 PRELIMINARY LITERATURE REVIEW

1.10.1 Introduction

Research has shown that play activities in ECCE attract children's interest in learning mathematical skills and concepts in their early development stages, yet not many practitioners practice play while teaching and learning mathematics in the ECCE setting (Rosli & Lin, 2018:1187). In order to address the aim and objectives of the study, the researcher began by reviewing the literature as reported by previous studies on the theoretical aspects guiding the study, namely social constructivism theory, rooted in the work of Lev Vygotsky. Social constructivism theory was discussed in relation to its origins, its importance, and its influence on practitioners' practices in mathematical play in the early years. Furthermore, this section reviewed preliminary literature from a global to a local context, focusing on the concept ECCE; mathematics

learning in ECCE; and discourse on the concepts of play and mathematical play. In addition, the section reviewed empirical studies that report on the importance of play in ECCE mathematics learning; perceptions on lived play practices of ECCE practitioners; challenges practitioners face when they adopt play in ECCE mathematics; and strategies for improving practitioners' use of play practice in ECCE learning. Lastly, a summary of the preliminary literature reviewed was given.

1.10.2 Theoretical framework

According to Grant and Osanloo (2014:13), a theoretical framework is a broad overview or a skeleton that can support a theory in a study, and serves as a blueprint on which the study can be constructed. This study has been anchored in the theoretical framework of the social constructivism theory of Lev Vygotsky. The basic assumption of this theory is that knowledge is co-constructed through social interaction. Vygotsky highlights the relevance of social and cultural interactions in the learning process. Vygotsky (1962) believed that, through social interaction with other people, particularly those who are more skilled, children's cognitive development is advanced. Thus, cognitive development through social learning enables children to actively construct their knowledge (Vygotsky, 1962). With respect to children's learning processes, Vygotsky is most recognised for his concept of the ZPD. For Vygotsky (1962), children who are in the ZPD for a particular task are almost able to perform the task independently, but need assistance on how to get there. In other words, children need to be assisted to perform the task successfully. The ZPD reflects Vygotsky's conviction that receiving instructions from someone is of immense importance for children's cognitive development. According to Vygotsky (1962), children are shown how to perform certain tasks, and they organise the new information received in their existing mental schemas in order to eventually learn how to perform the task independently. Vygotsky's social constructivism theory emphasises that children learn through social interaction with a more skilled person, who is known as the more knowledgeable other, who can be a practitioner or a peer.

This theory is relevant to healthy children's development. As children work with a more knowledgeable other (a practitioner), they interact with people and can, therefore, acquire information from a more knowledgeable other. The literature shows that social constructivism theory views a child as an active agent, who is constructing new ideas

through teaching and learning in the ECCE setting. This theory is child centred and proposes that children are involved in their learning as active participants, who construct their own knowledge with the help of the knower in a social context (Excell & Linington, 2015:28). According to Machaba (2013:234), this theory also explains that children are able to demonstrate their mathematical play knowledge and apply it in their daily lives. For example, a child can work out a sum and arrive at a solution, which they can share with other children in and outside the classroom while playing, and this is how the social context plays a role.

A study by Papalia and Feldman (2011:34) supports the approach proposed by Vygotsky, which stresses the engagement and collaboration process in teaching and learning, particularly of mathematical play in the ECCE setting. This implies that both child-initiated activities and practitioners guide activities that are vital during the teaching and learning of mathematical play.

1.10.3 Early childhood education and care in context

Studies have shown that, globally, the field of ECD uses several concepts and definitions to describe early childhood services and programmes for children up to the age of 8 years. The most commonly used terms include early childhood education and care and development, ECD, ECE, and ECCE (Young, 2015:8). According to Mbugua and Trube (2018:1), early childhood education and care development programmes are overarching programmes, which are designed to promote the holistic development of children ranging from birth to 8 years of age. In addition, Storli and Hansen Sandseter (2019:67) describe the ECCE institution as an early childhood setting designed to meet the needs of and ensure educational care for children from birth to 6 years old. The International Labour Organization (2012:71) defines ECE as a concept that refers to the education of children from birth to 6 years, before formal schooling in public schools. ECD is defined as the education of children from birth to 8 years, which are regarded as the critical years for development and learning in early childhood (Mugweni & Dakwa, 2013:315).

Empirical evidence has shown that, in the South African context, ECCE is a new concept that emanated from ECD. According to the RSA DSD (2015:11), ECD is a partial care facility that provides an early childhood programme with early development, and which focuses on children from birth until the year before they enter

Grade R/formal school. In South Africa, Aubrey (2017) postulates that, through the Notational Integrated Plan, ECCE was initiated to promote and address all the needs of children from birth to 4 years of age. These programmes are coordinated through two different government sectors (the DSD and DBE) and are located in public and private schools, as well as in non-profit organisations (Biersteker; 2012:52; Murray & Rudolf, 2019:16). The researcher's view on the discussion above regarding ECCE is that, although different abbreviations are used in different countries to conceptualise and interpret this concept in different contexts, it is vital to indicate that ECCE revolves around the development and support from birth to nine years old, before the chid enters formal school.

Nilsen and Steen-Johnsen (2020:86) highlight that what ECCE initiatives have in common are that they cater for children before formal school, or below 8 years old. This means they are a partial care facility that provides an early childhood programme with an early learning and development focus for children from birth until the year before they enter Grade R/formal school (DSD, 2015:11). In the context of this study, I adopted the concept ECCE as referring to a programme that provides education and stimulation for the holistic development of children from conception until the age of eight years (DSD, 2015:11 & DHET, 2016:6).

1.10.4 Mathematics learning in the ECCE context

The literature indicates that children's mathematical ability at an early age is the strongest predictor of later school success, regardless of gender or socioeconomic status (Bruce, Flynn & Bennett, 2016:542). Therefore, understanding mathematics provides a foundation for young children's appreciation of mathematics concepts, such as pre-numbers, number operations, measurements, shapes and time, which are important components of ECCE mathematics learning (Rosli & Lin, 2018:1187). Vijayan (2018:52) argues that children use numerous unique ways and styles to learn mathematics; these ways and styles differ from that used for mathematics teaching and learning in a formal school. According to Parker and Thomsen (2019:32), children use styles such as experimenting, which fosters social and interpersonal skills and expands social networks beyond learners' contexts. Playing with scoops and small containers to measure water, mix water and any combination of earth, sand or clay,

and picking flowers of different colours are some of the unique ways of learning mathematics in the ECCE setting (Turner & Williams, 2020:4).

Teaching and learning mathematics have always been a complex and challenging endeavour, globally and locally. In the South African education system, the introduction of the CAPS and the NCF for children from birth to four years old demonstrates an integrated approach to what mathematics education in the ECCE setting entails (DBE, 2011:14; DBE, 2015:8). According to the DBE (2011:14), children acquire mathematics skills in the kinaesthetic stage, the concrete stage and the abstract stage. Baloyi-Mothibeli (2018:110) asserts that, during these stages, children can climb over and under different outdoor and indoor equipment, play with balls, and balance on one leg while counting, among other activities in the ECCE setting that involve all five the senses.

Research has shown that educators play a critical role in shaping mathematics learning opportunities available to children; this guidance should be given in an active, playful way (McLachlan, 2019:9). However, the literature indicates that there is uncertainty among practitioners about how to support and integrate play in young children's mathematics learning (MacDonald & Murphy, 2019:1). This researcher's view on the empirical evidence presented in this section is that, in order for children to learn mathematics effectively, play should be integrated in all mathematics activities in the ECCE setting.

1.10.5 The rural context of ECCE provisioning

Research reports that rurality and rural schools are conceptualised differently in different contexts, for instance, rural is defined in terms of proximity to a city, or by demographic perspective. Such unique differences remain complex to define, particularly in an ECCE setting (Myende, 2015:33). Therefore, literature reveals that the definition of rural ECCE, in both global and local contexts, relates to young children from birth to 4 years old and this is a period of human development from birth to the year before a child enters Grade R/formal school and their intertwining needs; ECCE is a critical step for laying a sound foundation and influence children in lower socioeconomic strata (Munene & Okwany, 2016:1 and DBE, 2017:8). This is not the case for ECCE in urban and peri-urban areas. In these areas, children are guided by practitioners who are trained; these children outperform children who have had no

experience in ECCE settings, and who lack exposure to play as a pedagogy, as espoused by the NCF (Biersteker, Dawes, Hendricks & Tredoux, 2016:335). The DSD argues that, whilst play is regarded as an important pedagogical tool to promote young children's learning and development in the ECCE setting, practitioners lack of knowledge on the importance of play in the early years, they do not know how to implement play-based learning programmes and fail to provide opportunities for children to interact in a child-centred supportive environment in an ECCE setting. These challenges may hinder children's early learning development, particularly regarding mathematics education (DSD, 2015:27). Additionally, Jha, Purohit and Pandey (2020:9) indicate that, in order to be responsive to the provisioning of ECCE to all children, it is necessary to recognise the contextual and cultural practices, and to enrich and intervene in the implementation of ECCE in marginalised areas. Furthermore, Mohangi, Krog, Stephens and Nel (2016:72) suggest that practitioners should be prepared to improve their understanding of children's diversity in order to deliver pedagogical knowledge, as this focus may also prepare practitioners for geographically diverse communities where they may find themselves placed for teaching and learning. A lack of understanding of diversity could hamper practitioners' mathematical play practices in the ECCE setting.

With regard to the South African rural context, little is known about the quality of ECCE centres. Because most children live in predominately rural areas, teaching and learning of mathematics through play may be compromised in the early years (Biersteker et al., 2016: 337). The rural context presents challenges, such as the isolated setting, lack of access to public transport, school attendance problems and diverse learner backgrounds, which have a negative effect on the delivery of education in remote, underdeveloped areas (Mohangi et al., 2016:72). In order to accommodate all children in schools in remote areas, the literature reports that multi-grade classrooms are common. In these classrooms, several grades, including ECCE, are accommodated and provided with teaching and learning together, due to a shortage of teachers, also at the ECCE level (Hannaway, Govender & Marais, 2018:3). In this study, I will argue that it is imperative that teaching and learning in rural areas is improved, and practitioners in rural communities made conscious of the role they could play in this regard. Hence, in this study, I intend to explore the factors that may impact on practitioners' mathematical play practices in rural ECCE contexts.

1.10.6 Discourse on the concepts of play and mathematical play

Globally, mathematical play, play-based mathematics or learning mathematics through play, may refer to the same concept, though various researchers define and describe it differently. For instance, Ehrenfeld and Heyd-Metzuyanim (2019:746) define mathematical play as a universal, unique and culturally situated practice; that emphasises turn-taking and transitions of interactional routines in the classroom. Their study also argues that more social interaction takes place in the classroom, through the cultural background of the child is neglected when teaching is done through mathematical play in the ECCE setting (Ehrenfeld & Heyd-Metzuyanim, 2019:740). In turn, Linder and Emerson (2019:324) view mathematical play as an activity that involves parents and is related to improved school readiness and academic performance in the EECE setting. This claim is echoed by the literature, which indicates that, during building-block play for mathematics teaching and learning, children create products that are a combination of art and science to solve problems; for example, assembling blocks or building a structure (Pirrone, Tienken, Pagano & Di Nuovo, 2018:44).

In contrast to these meanings of mathematical play in different contexts, in South Africa, mathematics and play are two separate concepts, though they are interrelated. These two concepts remain universal and are often used to complement each other in teaching and learning, particularly when practitioners introduce mathematics concepts in a playful way in the ECCE setting (Helmbold, 2014:4). Mathematics and play influence each other and cannot be successfully implemented in silos in the ECCE setting. For instance, the NCF (DBE, 2015:14) states that, through play, children are exposed to different mathematics concepts, such as numbers, counting, sorting, classifying, comparing, solving problems and discovering shapes, space and measurement. Excell and Linington (2015:252) claim that mathematical education should be reinforced incidentally during literacy, science, art, movement and free play, to enhance perceptual motor, skills comprise the biggest part of child development in the ECCE setting. In addition, Zosh et al. (2018:4) explain that play is about continuity, by bringing together children's spheres of life – at home, in school and in the wider world – thus, exposing them to multiple opportunities. These multiple opportunities range from sorting and matching blocks, toys, and play material according to colours, size or shapes, and measuring spaces, shapes and dimensions. The researcher

agrees with the above discourses by various scholars, namely that understanding mathematics through play should be advocated and implemented by all practitioners who serve young children in the ECCE setting.

1.10.7 Review of related empirical studies

In this section, related empirical studies will be reviewed. These studies cover the importance of play in ECCE mathematics learning, perceptions of lived play practices by practitioners, challenges faced by practitioners when they adopt play practices, and strategies for improving the use of play practices in ECCE mathematics learning. I will also summarise the preliminary literature review.

1.10.7.1 Importance of play in ECCE mathematics learning

Having investigated different discourses relating to the concepts of play and mathematical play from global to local perspectives, the researcher deemed it necessary to explore the importance of play and mathematics learning for assisting children to acquire mathematics competencies in the ECCE setting. Aronstam and Braund (2016:2) indicated that play empowers young children to develop skills for critical thinking, creativity and collaboration while they work and interact with adults and peers. The same study reveals that it is during this time that children construct knowledge about events, the environment and people around them. A study by Hedges (2019:4) emphasises that mathematical learning has become an important a gatekeeper for literacy. Therefore, it is important for all members of society to achieve mathematics competency. Another aspect for which the same study found considerable evidence is that early mathematics learning skills are regarded as a strong predictor of later mathematics achievement by the child.

Research conducted by Stites, Sonnenschein, Dowling and Gay (2021:2) demonstrates that incidental exposure to playing mathematical games and engaging children in other mathematics-related activities is vital, as children develop an interest in mathematics. A study conducted by Broström (2016:5) describes play as the highest expression of human development in childhood, for it alone is the free expression that a child's soul has been taken into consideration, and paves the way for the idea of unrestrained free play in the ECCE setting. Furthermore, play is important for behaviour modification of children, and leads to an advanced level of development, by

providing avenues for children, not only to explore their environment and build their personalities, but also to construct knowledge that is unique to them (Ogunyemi and Ragpot, 2016:6; Broström, 2016:5).

Studies have also revealed that one of the requirements in the ECCE teaching context should be to provide diverse, special play areas or corners which include a theme table, fantasy area, block area, book area and mathematics area, where the child can learn and experience the importance of play and mathematical play (Chiparange, 2016:171). Empirical evidence provided by Papandreou and Tsiouli (2020:1) illustrate that, when children use money to buy things, calculate quantities during cooking, and indicate important dates on a calendar, they are already experiencing the importance of mathematical play and participating in everyday mathematics in the ECCE setting. That is why play is so important for ECCE learning. Hedges (2014:200) insists that practitioners should come forward, and locate themselves within the play-based teaching and learning approach, thus, linking content with play in the early years. Surprisingly, there is little research on mathematical play in the South African ECCE context; most researchers have concentrated on play-based learning in general, and have not studied a specific subject or area.

1.10.7.2 Perceptions on lived play practices of ECCE practitioners

Research has shown that, over the past few decades, the importance of children's education has attracted greater attention, and the number of studies on education has increased (Turupu, 2014:28). The question one should ask is how the individual practitioner perceives and applies play in the ECCE setting.

Linder and Simpson (2018:275) state that there are varying oppositional perspectives on the mathematics young children should learn, how this content should be implemented, and what role play should occupy in early childhood mathematics teaching and learning. Research has shown that decisions made about practitioners' practices influence their beliefs, knowledge, and experiences about mathematics, which can assist or hinder learners from learning mathematics through play (Ritter, 2019:40). It appears that practitioners in ECCE perceive play as affording children the opportunity to explore natural elements and develop physical abilities in a setting that has been carefully organised and is safe (Bento & Costa, 2018:291). The literature shows that it is essential that practitioners in the ECCE setting are

knowledgeable – it reflects a basic philosophical or pedagogical orientation in the teaching and learning environment (Brandt, 2013:229). In addition, different approaches towards teaching and learning are embedded in practitioners' everyday practice, which contributes to their interaction with children's daily lives (Brandt, 2013:229). However, there is the perception that practitioners view learning through play as a privilege that boosts their teaching agenda, and not as an essential way to promote children's development to expected levels (Colliver & Fleer, 2016:1560).

According to Makeleni (2018:40), practitioners' beliefs and practices have been regarded as information gathering about their influence and ability to implement their teaching and learning through a developmentally appropriate practice approach during learning through play. Scholars believe that, when the qualities of play are discussed, practitioners should look at the meaning attached to the concept of play, so that they have a clear understanding of how play affects the creative thinking of children (Fatai, Faqih & Bustan, 2014:260). Aronstam and Braund (2016:2) point out that, in the ECCE setting, some parents believe that play is, to some extent, commonly associated with a formal setting, rather than involving activities that are informal and appropriate for children. In contrast, the same parents often see informal play as lacking rules and intrinsically motivated. The literature perceives teaching and learning in the ECCE setting as diverse, and involving a variety of learning styles. Thus, children can participate actively and effectively when they are engaging in mathematics through play (McLachlan, 2018:30).

1.10.7.3 Challenges practitioners face when they adopt play practices in ECCE mathematics learning

Regardless of the importance of play and mathematics learning through play discussed in the preceding paragraph, there is growing concern about the way integrating play is disappearing from the ECCE setting (Bubikova-Moan, Næss Hjetland & Wollscheid, 2019:776). This concern might influence practitioners' play practice in ECCE mathematics learning negatively.

Somerville and Williams (2015:103) identify a lack of resources as a challenge facing practitioners, and which impedes their implementation of play-based learning in the ECCE setting. Ntumi (2016:54) indicates that, in order to successfully implement teaching and learning in a classroom, there should be adequate teaching and learning

resources. Along with limited teaching and learning resources, overcrowding of children in the ECCE setting also constitutes a challenge. The literature indicates that there is a shortage of trained staff, and a shortage of specialists in the ECCE field (Chhabra, Bose & Chadha, 2018:235).

The European Panel on Sustainable Development (EPSD, 2010:7) reports that little attention has been paid by academic institutions to improving the accessibility and content of education for sustainable development in the ECCE setting. The literature reports that one of the challenges that hinders practitioners from engaging children in a responsive way and promoting opportunities for children to learn mathematics in a playful way, is the lack of infrastructure. In most cases, practitioners find themselves teaching and supporting 20 or more children in small classrooms in the ECCE setting, even, sometimes, under trees (Jansen, Pyle, Alaca & Fesseha, 2019:492). This implies that, when a classroom setting is spacious and well organised, practitioners have more opportunity and time to interact with each child academically and developmentally, as well as having proper structures to accommodate all the children.

Research conducted in South Africa on ECCE learning found that there is lack of proper standardised training for practitioners of young children from birth until 9 years of age (Feza, 2016:486). Biersteker et al. (2016:335) mention that the physical setting, teacher–child ratio, group size, infrastructure, teacher qualifications, learning materials, and practitioners' classroom interactions and practices are common challenges in ECCE mathematical play. The services offered at the ECCE centres are not sufficient to promote optimal child development (Berry, Dawes & Biersteker, 2013:27). The implication of the research evidence reported in this section is that practitioners face common challenges across the globe; these challenges negatively affect the implementation of effective play practices in ECCE mathematics learning.

1.10.7.4 Strategies for improving practitioners' use of play practices in ECCE mathematics learning

Having identified challenges faced by practitioners when they adopt mathematical play in the ECCE setting, strategies that can assist practitioners to practice mathematical play effectively, will be discussed. To address these challenges, the Department of Education and Child Development in South Australia, implemented a numeracy strategy to support practitioners in identifying mathematical features of

children's interaction in the ECCE setting (McCluskey, Mulligan & Van Bergen, 2018:537). The literature also suggests using math packs that children take home, with the aim of encouraging parents to be involved in their children's mathematical play development, and enhancing children's early mathematics understanding (Linder & Emerson, 2019:323). Another study suggests that a child-centred approach and playful learning programmes are important for promoting sustainable academic performance, instead of more traditional, academically focused programmes (Hedges, 2019:22). Kaya and Aydın (2014:1621) suggest that a classroom environment that encourages reflection by employing mathematics communication will create an opportunity for children to reflect upon and develop their mathematics thinking. In this setting, students are encouraged to listen, pose questions and comment. Research by Makeleni (2018:30) suggests that a framework of developmentally appropriate practice is the most influential strategy, which will improve practitioners' use of play practices in ECCE mathematics learning. Developmentally appropriate practice is defined as a blend of the two concepts: age appropriateness and individual appropriateness, to support the development of the child (Makeleni 2018:30).

As mentioned earlier, there is a lack of professional development in the field of ECCE. For this reason, the Department of Higher Education and Training (2017) developed its policy on 'Minimum Requirements for Programmes leading to Qualifications in Higher Education for Early Childhood Development Educators' [MRQECCE] (Zulu, Aina & Bipath, 2022:1). Erasmus, 2019:15) shows that, to produce quality ECCE practitioners, educational opportunities have been created through various methods of training and short skills programmes (Erasmus, 2019:15); these include learnership programmes that were developed by the South African Qualification Authority (SAQA) through the National Qualifications Framework (NQF) with the aim of improving the qualifications of practitioners (Atmore; 2013:157).

1.10.7.5 Summary of preliminary literature review

In the ECCE setting, learning experiences can have a powerful impact on children's later-life outcomes. The question is how practitioners' lived mathematical play practices in ECCE settings affect the teaching and learning of children. In the preliminary literature review, the theoretical framework related to children's learning,

concepts of ECCE, and mathematical play were discussed in different contexts, in order to give an overview of what ECCE play and mathematical play entails. Throughout the preliminary literature review and the review of related empirical studies, common preliminary findings were identified; for instance, that there has been little or no research in the ECCE setting related to mathematical play. Most of the research in this area is on play only, or on play-based learning in general, and not specifically directed at mathematics. The shortage of professional development opportunities for practitioners, limited resources, the high teacher-pupil ratio, and inadequate infrastructure are regarded as huge gaps all over the world that impede effective mathematical play, as indicated by a number of scholars. This shows that the ECCE setting still lags behind with respect to the implementation of mathematical play learning. This backlog has a negative impact on the sustainability of teaching and learning in ECE, particularly in the ECCE setting.

1.11 RESEARCH METHODOLOGY

1.11.1 Introduction

This section presented the research methodology. Owing to the researcher's focus on practitioners and children in the ECCE setting, the study employed qualitative research, which was considered the most appropriate research approach. This approach assisted the researcher to obtain a natural means for collecting data that would provide in-depth insight into the phenomenon under investigation. McDowell (2020:12) explains that, in contrast to quantitative research, where conditions are controlled and variables are managed, qualitative research is conducted naturally in everyday life settings related to the phenomenon under study. This section presented the research paradigm, research approach, design of the study, research site, participant selection, instrument used for data collection, instruments to ensure credibility; triangulation and trustworthiness, data collection procedures, and data analysis.

1.11.2 Research paradigm

This study drew from the interpretive paradigm. According to Nieuwenhuis (2016:60), the interpretive paradigm considers the subjective interpretations of human beings and their perception of their life worlds as their starting point in understanding social

phenomena. This paradigm was adopted because it gave the researcher the opportunity to study the problem in-depth and in its context.

The literature indicates that interpretivism is socially constructed with participants; and considers their cultural backgrounds, beliefs, experiences and professional dispositions (Nieuwenhuis, 2016:61). Therefore, the interpretive paradigm was relevant to the study, because assisted in understanding practitioners' lived mathematical play practices in the ECCE setting, as this paradigm foregrounds the meaning that individuals assign to their experiences (Jansen, 2016:22). It was expected that this paradigm would contribute rich data to the study by investigating the phenomenon as it naturally exists and by observing real-life situations in the ECCE setting where teaching and learning takes place.

1.11.3 Research approach

The study used qualitative research, which is an approach to exploring and understanding the meaning ascribed to a social or human problem (Creswell, 2014:33). In addition, it involves emerging questions and procedures, and data is collected in the participants' setting. Terre Blanche, Kelly and Durrheim (2010:272) maintain that, in qualitative research, the researcher seeks to obtain descriptive information through interpreting participants' feelings and actions in human terms, rather than through statistical presentation. This study will use qualitative research to obtain first-hand information from the participants, while interacting with practitioners and observing children learning through play during mathematics instruction, as indicated by the daily programme in the ECCE setting. This approach is relevant to the study, as it emphasises that people's lived experience is profoundly linked to the meaning individuals attach to the daily events and processes of their lives (Daries, 2017:62). In addition, the qualitative approach allows for observation of the effect that it takes place in the real-world context (Daries, 2017:63). Thus, for this study, practitioners' practices were very important, so that their lived experiences during mathematical play in the ECCE setting could be explored.

1.11.4 Research design

This study adopted a phenomenological research design. A phenomenological research design is a qualitative method that seeks to describe the lived experiences of individuals in relation to a phenomenon, as described by participants (Nieuwenhuis,

2016:105). According to Creswell (2016:57), phenomenologists focus on describing what all participants have in common, as they experience a phenomenon universally. This design has strong philosophical underpinnings and typically involves conducting interviews (Creswell, 2014:43).

Bevan (2014:136) argues that the interview is by far the most dominant method for collecting data in phenomenological research; however, despite this dominance, there are few instructions as to how it should be undertaken. The researcher will use this design to understand how practitioners' lived mathematical play practices are implemented in the ECCE setting.

1.11.5 Study site

In order to manage the proportions of the study, the study site is limited to the Motheo District in the Free State province of South Africa. The researcher focused on five community-based learning centres that were privately owned in informal settlement areas. These are centres the researcher monitored and supported during her tenure at the Free State Department of Education (DoE) four years ago; another reason for selecting these sites relates to proximity. The researcher continues to have a good relationship with these community-based centres (CBCs). The researcher has been involved in training practitioners in the NCF for birth to four years old at those centres. During teaching practice, student teachers visit those centres for their teaching practice, and they gave the researcher a chance to explore and gather more data regarding practitioners' practices.

These CBCs were conveniently sampled. I expected my positive relationships with the centres to have a positive impact on data collection, and that I would be able to collect in-depth interview data and have relaxed observation sessions. The findings from the study will be relayed to the Motheo District, as the research will be conducted only in this area.

1.11.6 Participant selection

The participant pool comprised 10 practitioners who were involved in the study. All of them were females, as the ECCE profession is predominately females, with few men in this profession. This profession needs specialised knowledge and skills on how to work with young children from birth to four years old. From each of the five selected

CBC, two practitioners were requested to participate in the study voluntarily. This means that three practitioners from each centre who were involved in teaching three-year-old children, and another three who were responsible for teaching the four-year olds, were involved. I expected that practitioners had obtained Grade 12 certificates, and were proficient in Sesotho, Setswana and English, as these are the predominant languages in Mangaung township, which has a diverse linguistic background. Therefore, it was important that practitioners were conversant with the languages used in this ECCE setting, so that they could share their practices when they engaged children in the teaching and learning through mathematical play. At the completion of the selection, the researcher invited the potential participants to an information session regarding the study.

1.11.7 Instruments for data collection

The main instrument for this study was a semi-structured interview guide, which was characterised by open-ended questions that had been developed by the researcher in advance. According to Maree (2016:37), interviews aim to see the world through the eyes of the participants, who can be valuable sources of information. In the study, the interview guide assisted the researcher to generate rich data, which helped her to understand the practitioners' experiences and practices in their natural setting, as the practitioners had knowledge about the topic under study (Fick, 2014:217).

In order to strengthen the study, observations were also included, to generate more data. Nieuwenhuis (2016:90) defines observations as the systematic process of recording the behavioural patterns of participants, objects and occurrences without necessarily questioning or communicating with the observed. In this study, the researcher observed both practitioners and children while they were engaging in mathematical play in the ECCE setting. The researcher was either a non-participant observer or a participant observer during the process of observation in the ECCE setting (Creswell & Poth, 2018:308; Kumar, 2019:275). The literature reports that the unique feature of observation is that it enables the researcher to obtain lived data in a natural setting (Cohen, Manion & Morrison, 2011:456). Observation provided first-hand information relating to the behaviour of practitioners and children in the classroom.

To enhance the instruments of data collection, various resources, including a reflection journal for recording the occurrences emerging from the participants' lived experiences in mathematical play, were used for the purpose of triangulation.

1.11.8 Instrument credibility and trustworthiness

According to Nieuwenhuis (2016:123), credibility relates to dealing with questions such as, how congruent are the findings with reality, and how does the researcher ensure that the reader will believe the findings of the study? In the study, I ensured credibility to enhance trustworthiness. Gunawan (2015:10) argues that a study is trustworthy if and only if the reader of the research project judges it to be so. Hence, I adhered to the principles of trustworthiness, which are credibility, transferability, dependability and conformity to ensure the research was validated (Gunawan, 2015:10).

1.11.9 Data collection procedures

Using multiple data collection procedures is one of the key characteristics of qualitative research studies. In this study, the researcher employed triangulation of data collection procedures. Cohen, Manion and Morrison (2010:141) posit that triangulation techniques attempt to map out or explain more fully the richness and the complexity of data by studying it from more than one position. First, the researcher will give the participants a chance to express their views and give their inputs, where necessary, through one-on-one interviews using the interview guide. Thereafter, the researcher will draw up a schedule with each practitioner that will include visits to their classroom for observation of teacher-directed activities, child-initiated activities, and free play during mathematical play practices using an observation schedule. The visit will include spending a morning and a lunchtime with children and accompanying them during different routines in the ECCE setting, in order to get a sense of the phenomenon being studied.

1.11.10 Data analysis procedures

The literature reports that data analysis tends to be an ongoing and iterative process. This means that data collection, processing, analysing and reporting are intertwined (Nieuwenhuis, 2016:109). Nieuwenhuis (2016:109) emphasises that, in qualitative research, the model of data analysis consists of three essential elements: noticing, collecting, and reflection; these elements are interlinked and cyclical. The researcher

used these models of data analysis to gain a deep understanding of practitioners' practices and experiences of mathematical play in ECCE. Specifically, the qualitative data to be collected was analysed using the thematic approach of coding, sorting, categorising, and transcribing.

1.12 ETHICAL CONSIDERATIONS

Ethical considerations are regarded as an important issue in education research. Researchers need to ensure that research would be conducted in an ethical manner before they enter the research site (Basit, 2010:56). One of the major characteristics of ethical research is to seek permission from the relevant authorities before collecting data. The researcher applied for permission from the DSD and applied for ethical clearance from the University of the Free State. After permission had been granted, the researcher invited the participants by writing letters to the selected CBCs. During the initial visits to the centres, the researcher explained all the documents relevant to the study and how the sessions would unfold. The researcher also clarified how the volunteer practitioners would benefit from the study. Respect for privacy, anonymity, confidentiality and protection of their rights was ensured.

1.12.1 Gaining entry

First, the researcher made a list of the CBCs, publicly and privately owned, and identified participants who could be included in the study. For a researcher, in the absence of permission, there is no access to any research site or field. Thus, the process of negotiating access acts as a gatekeeping mechanism for participants' involvement, consent and permission, and ethical clearance. In this instance, the practitioners acted as initial gatekeepers in the research process. The researcher visited ECE CBCs after obtaining permission from the DSD to gain entry, and then generated interest in practitioners in taking part in the study. Before interacting with practitioners, the researcher adhered to the ethical principles of the University of the Free State, which are as follows.

1.12.2 Participants' rights

The researcher acknowledged and valued participants who committed to taking part in the study and sharing their lived experiences. The researcher informed them that their participation was voluntary and that, if they did not want to respond to some of

the questions during the interview, they had the right to refuse to give an answer. The researcher made them aware that, if they wished to withdraw from the research at any time, they were free to discontinue their participation without any penalty.

1.12.3 Informed consent

The researcher had to inform each individual about what would occur during the research study, the information that would be disclosed, and the intended use of the research data by the researcher (McKinlay, 2016:63). The researcher obtained voluntary consent prior to starting to collect data from participants. In addition, the researcher read and explained the information on the consent form prior asking participants to sign and return the forms.

1.12.4 Confidentiality

On the consent form, the researcher clearly informed the participants that confidentiality, respect and privacy would be maintained throughout the study. Participants were requested not to mention their identity in any of the study documents, to avoid linking their personal data to their responses. The researcher used the data and pictures solely for research purposes, and used pseudonyms for identification purposes.

1.12.5 Protection from harm

Three principles have to be considered regarding participants in a research study: first, having respect for participants' privacy, second, obtaining informed consent, and third, protecting participants' identities. The researcher minimised harm and risks that might have hampered the full participation of the participants, and ensured that they benefited optimally from participating in the study. In this study, the researcher ensured that none of participants were exposed to any form of harm, by not asking private and sensitive questions, thereby preserving an atmosphere of serenity and safety throughout the sessions.

1.12.6 Achieving anonymity

The researcher ensured that the anonymity of the participants was preserved throughout the study. No names of participants are publicised anywhere in the study and anonymity is maintained by using pseudonyms. The researcher will present the

generated data in an anonymous manner to protect the participants' identity. The researcher will keep the data in a strong-room with a code known to the researcher only, though the data will be available to participants on request.

1.12.7 Maintaining professionalism

In order to maintain professionalism, the relevant officials who managed the centres, practitioners, ECCE associations, ECD forums and professional bodies were invited, through a formal written letter, to the information session. During this information session, the purpose, aims and objectives of the study were explained in detail and the roles they would play in the study, as legal representatives of other practitioners, were explained. To uphold ethical requirements, the researcher also disclosed verbally her position as a lecturer in the ECCE field at the local university.

1.12.8 Participants' vulnerability

The researcher took precautions when involving practitioners who seemed to be vulnerable during the fieldwork. Mukherji and Albon (2010:36) explain that the vulnerability, uniqueness and small physique associated with being young and less experienced can result in researchers viewing participants as objects of research, as opposed to living subjects. During fieldwork, I realised that I was working with participants who had a wide range of needs and personal circumstances. For instance, some were unable to understand the mathematical concepts and lacked competency in teaching in the ECCE centres. I guided them through each interview question and explained the questions in the participants' own languages. Where questions required personal information that was sensitive, I assured participants of confidentiality, and respected their decisions if they indicated that they did not want to share personal information. I indicated to all the participants that, should they realise that they were affected by our discussions in any way, they were free to contact me or my supervisor. I referred them to the invitations that contained our full contact details. I also provided them with the contacts of various professionals should they feel they needed to consult someone.

1.13 ORGANISATION OF CHAPTERS

The thesis is organised into five chapters, and the structures is as follows:

Chapter 1: Introduction and background to the study

Chapter 1 provided the introduction, background of the study, problem statement, rationale for the study, the specific objectives of the study, the main research question, delimitations of the study and the operational concepts that will be used in the study. In addition, the chapter reviewed literature relating to previous studies on the theoretical framework that guided the study. This chapter placed ECCE in context; and discussed mathematics in ECCE, and the discourse on the concept of play and mathematical play. Furthermore, empirical studies highlighting the importance of play, perceptions on lived play practices of ECCE practitioners, challenges practitioners face when adopting play in ECCE mathematics leaning, and strategies for improving practitioners' use of play practice in ECCE learning were reviewed.

Chapter 2: Theoretical framework and literature review

This chapter provided a logical presentation of the theoretical framework in relation to its origin, its importance, and its relevance to the study. Furthermore, the chapter presented a literature review from a global to a local context, by focusing on the concept of ECCE, mathematics learning in ECCE, and the discourse on the concepts of play and mathematical play. In addition, the section reviewed empirical studies on the importance of play in ECCE mathematics learning, perceptions on lived play practices of ECCE practitioners, challenges practitioners face when adopting play in ECCE mathematics, strategies for improving practitioners' use of play practice in ECCE learning, and lastly, a summary of the literature was reviewed.

Chapter 3: Research methodology

Chapter 3 contained an introduction to the research methodology, the research paradigm, the research approach, the design of the study, and the study site. Furthermore, the chapter scrutinised the selection of the participants, data collection instruments, and credibility, including trustworthiness. In addition, the chapter discussed the data collection procedures using the triangulation technique, analysis procedures, and findings. The chapter concluded with a discussion on ethical considerations and processes, namely gaining entry to the research site, participants'

rights, informed consent, confidentiality, and protecting participants from harm. The researcher will also discuss achieving anonymity, and maintaining professionalism, as well as acknowledging participants' vulnerability.

Chapter 4: Data analysis and interpretation

This chapter will present the data generated in a systemic way, followed by an analysis and interpretation of the data. The chapter also discussed the analysis and interpretation of data and findings in relation to the literature and the research problem.

Chapter 5: Discussion, conclusions and recommendations

Chapter 5 included a summary of the important findings, conclusions and recommendations of the study, and further research suggestions.

1.14 CHAPTER SUMMARY

This chapter focused on providing an introduction and background to the study, the problem statement, and the rationale for the study. The aim of the study, specific objectives, the main research questions and sub-research questions were given. In addition, the delimitation and significance of the study, as well as definitions of operational concepts, concept clarification and a chapter outline of the study were discussed. The chapter also included a preliminary literature review, and reviewed related empirical studies, and provided a brief orientation of the theoretical framework used in the study.

The chapter also presented the research methodology that was applied. The research paradigm, research approach, design of the study and information about participants and settings of the study were represented. Then, the data collection instruments, data collection procedure and data analysis procedures were explained. The nature of a qualitative study was explained, and the issues related to the quality of the research (credibility, triangulation and trustworthiness) were addressed. The proposal discussed ethical issues, which consisted of gaining entry, participants' rights, informed consent, confidentiality, protection from harm, achieving anonymity, maintaining professionalism, and participants' vulnerability. Finally, the chapter ended with the organisation of chapters and a summary.

CHAPTER 2
LITERATURE REVIEW

2.1 INTRODUCTION

The previous chapter provided an overview of the study. In this chapter, I reviewed the literature related to practitioners' lived mathematical play practices in the ECCE setting. According to Vithal and Jansen (2012:16), a literature review is defined as the overview of current and previous research relevant to the topic under study. It requires more than a quick scan, but involves an in-depth reading about the topic being researched (Winchester & Saljir, 2016:308). Arshed and Danson (2015:31) recapitulate that a literature review involves extracting vital information and synthesising the main ideas, points, issues and findings that emerge from a review, and summarising a body of literature.

By presenting a comprehensive literature review in this chapter, I gained an understanding of the phenomenon I am studying, identified the gaps in knowledge, and be able to recommend areas for further study. Firstly, I focused on gaining an overview of the theory that informed methodology and data analysis of the study. Secondly, the way the social constructivism theory as propounded by Lev Vygotsky was applied to navigate the study and related constructs were discussed in relation to what other researchers have said about the phenomenon under study. By doing so, I was able to identify gaps that might exist in the knowledge about the topic, and sought to address these gaps through this study.

The conceptual framework describing the concept of mathematical play learning was discussed in depth. A conceptual framework serves as the cement that holds the components of the research together – it cannot be separated from the theoretical framework. Moreover, if a conceptual framework is lacking, the research design falls apart (Ngulube, 2018:1). Hence, in this study I discuss mathematics learning in the ECCE context, particularly the rural context. Furthermore, a discourse on the concepts of play and mathematical play was provided. Thus, I ensured that all the different components of the study are integrated in a coherent and logical order, to address the research problem effectively. In addition, I reviewed related empirical studies on play

and mathematical play practices in relation to the importance of play in ECCE mathematics learning, perceptions on lived play practices of ECCE practitioners; constraints to adopting play practices in ECCE mathematics learning, strategies for improvement, as well as the implications of the review for the current study. Finally, a summary of the chapter was provided.

2.2 THEORETICAL OVERVIEW

This section provided a theoretical overview in order to introduce and describe the theory that guide this study. Kivunja (2018:44) indicates that, at several universities, the concepts theory, theoretical framework, and conceptual framework are among the topics that many students appear to be unable to conceptualise when they conduct research. Literature explains that a theory is a generalised statement of interrelated concepts, definitions and propositions that explains or predicts ideas or situations within the limits of critical, bonding assumptions that constitute deep, broad-based knowledge about the research topic (Kivunja, 2018:45; Glanz, 2017). Ridder (2017:293) defines a theory as components (concepts and constructs) used to identify the necessary elements of the phenomenon under investigation and explaining the underlying the relationships between them.

In this section, the theoretical framework guiding the study and the related constructs was discussed. This provided the insight necessary for contextualising practitioners' lived mathematical play practices in the ECCE setting. Grant and Osanloo (2016:13) posit that a theoretical framework serves as a guide that can be used to build and support research and which provides the structure for approaching the study philosophically, epistemologically, methodologically, and analytically. Collins and Stockton (2018:2) explain a theoretical framework as the intersection of existing knowledge and previously formed ideas about complex phenomena, the researcher's epistemological dispositions, a lens, and a methodically analytical approach in research.

This study is framed within Vygotsky's social constructivism theory (1978). Through this theoretical framework, I hoped to reflect on the stance that anchored and facilitated the dialogue between literature and the research methodology adopted for the study. I also hoped to understand and gain insight into the way practitioners contextualise ECCE and their lived mathematical play practices in the ECCE setting.

2.2.1 Social constructivism theory of Lev Vygotsky

Central to Lev Vygotsky's (1978) seminal work are the social aspects of acquiring knowledge. It is, thus, particularly important for the South African context, since it acknowledges the importance of social, cultural, and historical processes in the formation and development of the child. Vygotsky's (1978) social constructivism theory states that knowledge is constructed through social experiences in different social contexts and, therefore, learners need to collaborate on different inter and intrapersonal levels of learning in their contexts. Vygotsky (1978:86) states that social interaction triggers the hidden cognitive level, which creates a gap between what the child is able to do on their own, and what the child is capable of doing with the proper guidance of an adult, whether caregiver or practitioner. He created a tool to help children to complete the task they would not be able to achieve without the existence of these tools, and he calls this tool a mediation.

Drawing from his own work on social constructivism theory, Vygotsky (1978) assumes that children can achieve more with the assistance of the so-called more knowledgeable other in the ZPD. According to Vygotsky (1978), the more knowledgeable other refers to someone who has a better understanding or higher ability level than the child regarding a particular task, process, or concept. He defines ZPD as the distance between what children can do by themselves and what they can achieve with competent assistance by more knowledgeable others (Vygotsky, 1978). Furthermore, he introduces the concept of scaffolding as a social guidance opportunity that can provide first-hand assistance to enable children to accomplish a given task, until they can work independently, when guidance is withdrawn by the more knowledgeable other (Vygotsky, 1978).

Vygotsky's social constructivism theory is well known in the field of sociology and communication. The idea is that knowledge and understanding work jointly to develop people's understanding of the world around them (Amineh & Asl, 2015:13). Social constructivism theory has three important assumptions, namely reality, knowledge, and learning (Vygotsky, 1978. Reality is constructed through human activity, while knowledge is socially and culturally constructed, and learning is a process that occurs when individuals are engaged in social activities (Kim, 2001). Furthermore, social constructivism emphasises culture as the main role player in a child's learning and

development during sociocultural activities with a more skilled person, such as a teacher or a peer (Excell & Linington, 2015:29).

This theory considers the vital role that society plays in the child's development, and how learning is largely dependent on the social environment (Hall, 2007:94). This implies that the child's family background, as well as participation in cultural activities, should be infused in programmes of practitioners' mathematical play practices in ECCE settings, in order to enhance the child's knowledge of play and mathematical play in their context. In my view, this theory relates well to the methodology that I employed in this study, as it helped me to achieve the objectives of the study. MacLellan and Soden (2004:254) argue that knowledge is not passively received from the world, but is co-constructed through a shared, adapted responsibility that makes sense to individuals as well as group of people, who experience the world around them with the help of others.

Vygotsky's assumptions are that the ZPD (in the ECCE setting) is an area where teaching and learning takes place through various tools that can assist children to complete the tasks expected of them by more knowledgeable others. Furthermore, Vygotsky states that, through mediation, more knowledgeable others employ scaffolding to guide children towards the completion of tasks that children might find difficult. Once children are able to work independently, this guidance is withdrawn. In this study, social constructivism theory assisted the researcher to understand the process that takes place in the ZPD when practitioners engage children in play and mathematical play practices in the ECCE setting. It helped the researcher to understand how practitioners mediate and scaffold children during mathematical play learning in the ECCE setting. This understanding also provided me with insight into the challenges facing this social interaction and the strategies to address the challenges.

The following concepts are deemed key in Vygotsky's social constructivism theory and were applied when I presented, analysed, and interpreted the generated data: social interaction and the more knowledgeable other, mediation, and ZPD, where scaffolding takes place.

2.2.1.1 Social interaction

Vygotsky's (1978) concept of social interaction is based on the notion that, to develop learning skills, such as reasoning, memory, attention, and language, the child must be encouraged to collaborate. Developing these skills requires that the child engages in play and mathematical play under the guidance of the practitioner in the ECCE setting. Vygotsky believed that it is through this interaction with, participation by, and facilitation of the more knowledgeable other that a child works towards the construction of new ideas (Vygotsky, 1978).

The more knowledgeable other is someone who has a better understanding or higher ability level than the child with respect to a particular task, process, or concept. In essence, social constructivism theory regards learning as a dual and reciprocal process, where the practitioner and the child engage in a realm where they support each other to construct a new idea; Vygotsky called this realm the ZPD (Vygotsky, 1978). He also assumes that the process of social interaction between the child and more knowledgeable others occurs through observation and collaboration and independently, which influences what children think, how they think and what type of communication is involved in the process of social interaction. Rubtsov (2017:29) argues that the concept of joint learning is characterised by distribution and exchange actions, mutual understanding, communication and cooperative work, which are explained by Vygotsky's social interaction process.

Vygotsky's work is still recognised and acknowledged by researchers all over the world. For instance, Amineh and Asl (2015:13) assert that, during the process of learning, individuals can create meaning when they interact with each other and with the environment they live in. Yüksel (2011:16) acknowledges the work of Vygotsky by agreeing that collaboration and interaction with more knowledgeable others and peers provide the child with support and increase the likelihood of achievement in the construction of new ideas, particularly through mathematical play in the ECCE setting. McLeod (2014:2) asserts that, through the interaction and modelling behaviour of a skilful tutor, important learning and development occurs in the child. This interaction cannot be separated from verbal instructions and dialogue between the child and the tutor. This implies that social interaction plays a fundamental role in learning, and influences children's engagement in mathematical play leaning in the ECCE setting.

2.2.1.2 Mediation

In a Vygotskian sense, the term mediation has a long history and has frequently been used to describe a situation where one entity plays an intermediary causal role in the relation between two other entities. Vygotsky (1978) defines mediation as a process during which children execute a task with assistance, which is more indicative of their potential than if children performed that task on their own. Vygotsky (1978) describes mediation as providing the foundation for his theoretical goals, namely building a link between social and historical processes, on the one hand, and individual mental processes, on the other hand. He maintains that language is a tool to mediate learning through understanding the social context, and building relationships between people (Vygotsky, 1978). Vygotsky believed that language develops from social interactions, for communication purposes and viewed language as man's greatest tool, a means for communicating with the outside world (Vygotsky, 1978). He considered private speech as the transition point between social and inner speech, the moment in development where language and thought unite to constitute verbal thinking. Vygotsky elaborates on the notion of scaffolding as part of mediation (Vygotsky, 1978). He regards scaffolding is as a social guidance opportunity that can provide first-hand assistance to enable the child to accomplish a given task independently; once the child can work independently, the scaffolding is withdrawn by the more knowledgeable other (Vygotsky, 1978).

Vygotsky's concept of mediation is also acknowledged by other researchers, from local to global contexts. For instance, Kozulin (2005:104) views the concept of mediation as a structured form of teaching that takes place in a unique social space created by the teacher in ZPD, using signs and tools which have social and cultural meaning. Gruzd, Kumar, Abul-Fottouh, and Haythornthwaite (2020:632) supports the use of mediation as a key aspect of knowledge co-construction, where both practitioners and children develop a bond and create learning together by giving themselves the required independent experience and demystifying teaching and learning during ECCE mathematical play education. Infante and Poehner (2021:3) argue that part of a mediator's responsibility is drawing learner attention to the details of the task, and explaining the signification of each element and how the elements together combine to lead to expected outcomes. They articulate the view that the

mediator's responsibility does not end with a one-time verbal explanation of these symbolic representations, but require a full, detailed representation of the task.

My belief is that the work of Vygotsky's social constructivism theory assisted me to understand the lived play practices practitioners (as more knowledgeable others), through mediation and interaction with children during play and mathematical play-based learning in the ECCE setting. My implication is that practitioners must prepare the environment (ZPD) as a unique social space where children will be guided through mediation and scaffolding to achieve learning. In the case of this study, the more knowledgeable others were practitioners or peers who had more advanced knowledge, who should be available to assist the child to acquire mathematical play practice skills in the ECCE setting.

2.2.1.3 Zone of proximal development

According to Vygotsky (1978), collaboration that enhances learning and development happens in the child's ZPD. He refers to ZPD as an exceptional teachable space where children can accomplish tasks on their own, and where they can achieve with the assistance of more knowledgeable others. In the ZPD, children operate on two levels, the low level, where they can complete the task independently, and the higher level, where the child can complete the given task with the aid of scaffolding by more knowledgeable others. The gaps that exist between those two levels of operating is termed the ZPD (Vygotsky, 1978).

McLeod (2018:11) believes that Vygotsky's theory feeds into the collaborative learning that exists on different levels of ability, where more advanced peers can assist less advanced persons to operate on their level of ZPD. This idea is supported by Bodrova, Germeroth and Leong (2013: 115), who report that the description of new developmental accomplishment emerging within a child's zone under the guidance of or in collaboration with a more capable peer has been most successfully applied in the ZPD with the expansion of play to enhance the child performance in the ECCE setting. In this study, I support the notion that practitioners should consider the ZPD when they implement mathematical play practices in the ECCE setting. Michael (2013:26) explains that a child who cannot solve a play-based mathematics problem might be able to do so with the help and guidance of more knowledgeable others. Through the interaction and collaboration with more knowledgeable others, within their ZPD,

children learn to use their intellectual tools for remembering and performing the tasks effectively.

Vygotsky's analysed the historical origin of the ZPD and discovered that education in a modern world is a result of the possibility of providing virtual support in the ZPD (Vygotsky, 1978). The implication is that, even when a child is at home and has the support and guidance of the practitioner, and performs certain mathematical play activities at home, a child will be able to complete that task, because the child already has a picture of how the practitioner guided them to execute the specific task. From a Vygotskian viewpoint, play is an eminently cultural activity, with adults assuming a role in engaging children and supporting and scaffolding play as it develops (Bodrova et al., 2013:115). Research shows that the ZPD has its place and plays a major role in the system of Vygotskian theoretical construction. Therefore, is important to position the ZPD where it belongs, in order to ensure a meaningful understanding of the concept (Veresov, 2017:27). Guk and Kellogg (2007:282) consider the ZPD to be essential for understanding school life, and should have a central place in the teaching-learning in EECE through mathematical play.

Even though ZPD is best known from Vygotsky's work, Hakkarainen and Bredikyte (2008:2) characterise the ZPD as two concepts: the school and play. This supports Vygotsky's notion that play creates a ZPD for the child beyond the child's average age and above their daily behaviour, which leads to an improvement of the child's school performance (Bodrova et al., 2013:112). It is in the social and cultural context of play that the ZPD is created and children are motivated and encouraged to learn through the assistance of more experienced others (Perry & Dockett, 2007:2). Furthermore, Bodrova et al. (2013:117) postulate that practitioners in the early childhood setting do not always support and practice play-based learning strategies, consequently, children fail and regress to more primitive ways of playing. I agree with the researchers reported above that, today, play has a very low level of engagement, and that play no longer foster the skills in the ZPD that can contribute to the development of mathematics education in the early years. Hence, this study aimed to carry out a phenomenological study of practitioners' lived mathematical play practices in the ECCE setting, to explore practitioners' current lived mathematical play practices, and how they prepare the mathematical play environment and ensure proper play practices in the ECCE setting. I examined the challenges that prevent proper mathematical play practices, and will

propose possible measures to ensure proper mathematical play practices in the ECCE environment.

Margolis (2020:16) states the concept of ZPD is the best-known concept in the work of Vygotsky. The importance of the ZPD varies, depending on its place in the system of concepts and in the description of various processes and objects studied within the framework of emerging cultural-historical theory. Norozi (2021:3) regards the concept of the ZPD as the area where the most instruction or guidance should take place, through mediation, and where the child's actual developmental level, as determined by independent problem-solving and the level of potential development-as determined through problem-solving under adult guidance, or in collaboration with more capable peers. In the following section, I will discuss another important component of the study, namely the conceptual framework.

2.3 CONCEPTUAL FRAMEWORK

A conceptual framework is a frame that explains core concepts of a study and how they relate to each other. Imenda (2014:189) defines a process of developing a conceptual framework as putting together several related concepts to explain an event or give a broader understanding of a research problem. The conceptual framework of this study was guided by the systematic clustering of the related concepts of play and mathematical play in the ECCE setting. These concepts will be discussed in relation to ECCE in the context of mathematics learning in the ECCE context, discourse on the concepts of play and mathematical play, and the rural context of ECCE provisioning. These concepts guided me to pull together the study and make sense of it; they also helped me to deepen my knowledge through the empirical literature review and during the fieldwork.

In this section, I will provide an overview of the conceptual framework, as indicated in Figure 2.1 below. The conceptual framework is based on concepts that were used to guide the study, in conjunction with practitioners' lived mathematical play practices in ECCE settings. I will elaborate on each construct and explore how they responded to the aim and objectives of the study.

Figure 2.1: Diagrammatic representation of the conceptual framework

2.3.1 Early childhood care and education in context

In both global and local contexts, ECCE is a focal point in the education arena, and has attracted many researchers. This field remains a priority for public policy worldwide (Garvis, Phillipson & Phillipson, 2021:291). Nilsen (2017:217) supports this statement by saying that the importance of ECCE for serving individual and societal development has gained attention in both developed and developing countries. Furthermore, Jenkins (2014:143) states that ECCE is recognised by stakeholders in education and features on the education global agenda as a necessary component of future economic and social development, in both developed and developing countries. Researchers report that countries worldwide vary considerably regarding the terminology they use to describe the concept of ECCE. It is called early childhood care and education, ECEC, early childhood care and development, early childhood, ECE and ECD (Nilsen, 2017:217; Jenkins, 2014:143; Obiweluozor, 2015:2, Rao, Umayahara, Yang & Ranganathan, 2021:2, Mpuang et al.2015:68; DSD, 2015:11; DHET, 2017:8). Even though the concept is called by different names, it has the same meaning, which is providing teaching and learning programmes for children from birth

to 8 years old (Correia, Aguiar & Amaro, 2021:9). Bodger (2020:1) defines ECCE as a service catering for children from birth to five years, after which children begin their formal year of schooling. Vu (2021:2), in turn, refers to ECE as infant education designed for children under seven years, which is managed and implemented by the education minister. It is also regarded as a programme from the child's first month to five years of their life (Boyd, Wong, Fenech, Mahony, Warren, Lee & Cheeseman, 2020:217). ECD programmes aim to promote children's development and learning in their early years through both government and community-based support structures (Shallwani, Abubakar & Kachama, 2018:29). Early childhood settings introduce literacy and mathematics activities to children at an early stage, and drive them to attain the required standards (Guirguis, 2018:43).

Ojinuka and Blaise-Okezie (2020:56) report that there are variations across countries about the age of children should be considered for ECE. Nilsen (2017:217) postulates that early childhood is a period that spans eight years, which is critical for cognitive, social, emotional, and physical development, and during which the child requires an adequately stimulating environment for social interaction with other children. The literature reports that ECCE in India is an integrated child development scheme in community centres, which is targeted at ameliorating health, nutrition, and physical, psychological and social development problems of children from birth to six years of age (Sharma, 2021:6475). In Greece, ECCE is also known as Educare, and refers to programmes that offer education and care. It is an approach to education that offers a developmentally appropriate mixture of education and care that stimulates and nurtures children during play-based learning (Rentzou & Daglas, 2018:82). In relation to the ECCE setting, Mbugua and Trube (2018:1) describe the concept of early childhood education and care development, which encompasses programmes and practices that are shared globally by stakeholders, government leaders, policymakers, researchers, academics, educators, community members, family members and children.

According to the DSD (2015:11) and DHET (2017:8), ECCE refers to the period of human development from birth until the year before a child enters formal school. Additionally, ECCE is chosen as a qualifier to name some of the qualifications in this Policy that are intended to develop educators who are able to support and promote

early learning and development for babies, toddlers and young children (DHET, 2017:8).

This period focuses on promoting the child's holistic development, which includes the involvement of parent support groups, outreach programmes, playgroups, childminders, toy libraries, and mobile programmes. Ebrahim, Killian and Rule (2011:388) view ECD as an important institution, which plays a supportive role in meeting the young child's rights to health, nutrition, care, education, and safety. The ECD is defined by the NDA (2012:1) as the process by which children grow physically, mentally, and socially from birth to nine years of age. Mubashar, Hashmi and Altaf (2020:632) agree with the NDA that ECD is a unique and diversified arena that attends to children from the time they are born until the age of eight years. In addition, Janse van Rensburg (2015:4) states that ECD includes the first years of education, hence, at the end of Grade 3 – in terms of children's chronological age, it entails education up to the age of nine. The DSD (2015:14) refers to ECCE as a programme that provides daily care, development, and education service and support to a child in ECD years. It explains, furthermore, that these programmes are run by community-based groups that operate for specific hours, and provide outreach support for young children and their families or care givers. In addition, these programmes provide parental support, and focus on the care, development and education of children from birth to school-going age. The DHET (2017:8) defines ECCE as the term chosen as a qualifier to name certain qualifications that are intended to develop educators who are able to support and promote early learning and development of babies, toddlers and young children. Janse van Rensburg (2015:4) explains further that, during these years (birth to nine years of age), a child learns to walk and to talk, acquires an identity, and learns mathematics and language. In this study, I will be using the term ECCE as defined by DSD (2015:11) and DHET (2017:8).

Given the various views on how ECCE is conceptualised across the globe, it is clear that ECCE is organised according to each country's perspective and sociocultural context in which the child is placed. My understanding is that, in South Africa, the education system for ECD is mainly categorised into different grades, and ECD serves as an umbrella body that provides an early childhood programme with an early learning and development focus for children from birth to eight years old. The categories are ECCE (birth to four years), Grade R or reception year (four and half to

five years) and foundation phase for children from six to eight years, and divided into Grade 1, 2 and 3. Therefore, ECCE is the period where most development and growth take place, which enable the child to cope and adjust in the social environment where teaching and learning occur. The ECCE programmes aim to care, support and provide a comprehensive education programme that involves all the stakeholders to ensure the holistic development of a child. It would appear that, even though these programmes focus on the holistic development of the child, the role of mathematics education and play-based learning is sometimes overlooked by practitioners, therefore, this study focused on practitioners' lived mathematical play practices in the ECCE setting.

2.3.2 Mathematics learning in the ECCE context

The research has shown that the early childhood years are a vital period for introducing mathematics learning, since doing so in the ECCE setting enhances children's positive attitudes towards mathematics and improves their trajectory in the development of mathematical concepts (Ochoa, 2019:3). Since children's mathematics competency plays a major role in national and personal achievement for children in the early years, many countries and mathematics experts attach great value to its cultivation in the ECCE setting (Wu, Zhang, Wu & Chang 2021:1). In this regard, Hwa (2018:260) states that mathematics serves as a vital tool in many fields throughout the world, including the natural sciences, engineering, medicine, finance, and social sciences. Oppong Frimpong, (2021:168) posits that experience in the early years that relate to quality thinking and socialisation are critical for the optimal development of the child, hence, the unique style a child uses when learning mathematics should be considered, in order to achieve quality education and development.

Simamora and Saragih (2019:61) state that mathematics education is devoted to establishing an understanding of mathematics concepts and ideas, which are then applied in routine and non-routine problem-solving, reasoning, communication, and connection development inside and outside a mathematics environment. The same study articulates that mathematics education is not only attached to students attaining success in completing school and graduating, but also leads to them acquiring high-skill jobs with high earning power. Lüken and Sauzet (2021:28) argue that, despite evidence of the effect that learning has on young children's skills, there is a link

between pattern knowledge and mathematical learning in the early years. Susilowati Miriam, Suyidno, Sholahuddin and Winarno (2020:2), furthermore, indicate that, because of children's uniqueness, different strategies must be employed when they are taught mathematics in the ECCE setting. Regrettably, there is limited understanding of what mathematics education entails, and what is required from the side of teachers who are responsible for offering mathematics in the ECCE setting (Ginsburg, Lee & Boyd, 2008:3).

Literature reports that early childhood teachers often lack the confidence, knowledge, and classroom practice skills needed to engage children in mathematics (Moss, Hawes, Naqvi & Caswell, 2015:377). Thus, early childhood practitioners bear the responsibility for preparing effective mathematics experiences for young children (Sheridan & Wen, 2021:99). Practitioners need to determine which mathematical learning opportunities are available for different groups of children in the ECCE setting (Stites, Sonnenschein, Dowling & Gay, 2021:67). Vijayan (2018:52) reveals that children learn in numerous ways and practitioners are expected to understand this, as well as to know which pedagogical skills to use in their day-to-day interactions in the ECCE setting. It appears that teachers' lack of skills and knowledge to explain mathematics concept is another factor that causes poor performance in mathematics, particularly in the early years (Siyepu, 2013:10). In contrast, a mathematics teacher who adopts a teaching style that is suitable for the learners' context, provides learners with the opportunity to illustrate mathematics concepts and construct new ideas, and will improve the academic achievement of learners (Bosman & Schulze, 2018:2).

Most young children are born with the capabilities needed to learn and construct new ideas to enhance their innate mathematics knowledge in the ECCE setting (Setoromo & Hadebe-Ndlovu, 2020:2). McDonald (2018:30) suggests that, in order to expand this mathematics knowledge, practitioners need to provide a conducive environment that is predominantly play-based to support children's mathematics education activities. Bezuidenhout, Henning, Fitzpatrick and Ragpot (2019:2) argue that many South African children fail to develop an understanding of mathematics concepts that are required for Grade 1. Setoromo and Hadebe-Ndlovu (2020:1) say that teachers of young children are expected to offer a mathematics education that exposes children to deep and explicit high-level mathematics knowledge, and to prepare them for learning in the formal environment. This practice will assist children to develop mental

processes that enhance logical and critical thinking, accuracy, and problem-solving, which will, in turn, contribute to decision-making, particularly in mathematics education (DBE, 2011:8).

Furthermore, the mathematics teaching approach should be based on the principle of integration and play-based learning, and should include all learners, irrespective of their socioeconomic status, background, race, gender, or physical ability to achieve self-fulfilment and meaningful participation in society as citizens of the country (DBE, 2011: 4). This statement advances the commitment of the Education for All policy, which was launched at the World Conference in 1990, and taken up by a number of countries of the world. The first goal of this policy is to expand ECCE and improve every aspect of education (Madani, 2019:100).

Stott (2016:26) carried out a study on making sense of the ZPD, an organising framework for mathematics education research in South Africa. The results reveal that individual children's learning trajectories differ, particularly in mathematics. Hence, there is a growing focus on differentiated teaching and symbiotic mediation, which emphasises social and cultural aspects of mathematics learning. Stott (2016:26) also found that learning often starts when the child can no longer continue on their own, and require intervention (mediation from more knowledgeable others) to perform a mathematics task successfully. This implies that not only children's competencies are expected in mathematics, but practitioners' pedagogy and pedagogical knowledge are also required if children are to be competent and master complex mathematical skills at a later stage. Therefore, there is a need for reciprocal understanding and knowledge of mathematics education in the ECCE context.

2.3.3 Discourse on the concepts of play and mathematical play

Given the rural context of much of ECCE, it is crucial to investigate the concept of play and mathematical play in the ECCE setting from the global to the local context. Literature has shown that play has a broad description, and it needs to be presented in a diverse context and accompanied by diverse methods in implementation. This practice will support both learning and development during childhood education (Pyle, 2018:8).

There are numerous definitions and descriptions of play. Historically, play has been described as process-driven, self-directed, and child-focused, and a freely chosen

activity that serves as an important tool for learning for the child (Glen, Knight, Holt & Sepence, 2013:186). Guirguis (2018:45) argues that the term play is difficult to define and articulate, because it is abstract and has multiple meanings, and is a complex phenomenon that differs according to the context and the experience of the children involved.

A study conducted by Pyle, Poliszczuk and Danniels (2018:222) reveals that children's play occupies an important role in the ECCE setting, and the role of the teacher is vital for nurturing children's early personal and social development through learner-centred activities that will assist children to construct new ideas. Pyle (2018: 8) states that play is often thought to be the primary occupation of children, and its potential for learning and development has been explored in research for decades. Scholars declare that play is a natural activity of human beings, mainly during the first years of life, and it acquires key, relevant elements from a pedagogical point of view at the level of ECE (Bastías, Flores-Lueg, Gonzalez, Espinoza & Tronscoso, 2021:1).

Pyle (2018: 8) explains that, despite the potential of play-based learning during activities, its pedagogical implementation is challenging, due to its definitions and differential implementation in the children's development in the early years. This argument is taken further by Bjelde (2020:3), who says that, although research has underlined the importance of play for future ECE, there are a number of diverse challenges that make it difficult to implement play-based learning in the ECCE setting. Bjelde (2020:4) claims, furthermore, that many teachers have abandoned play-based learning in attempts to increase children's performance. However, reducing play-based learning impacts negatively on learning and development of children in the ECCE context. Instead, Erşan (2017:54) suggests, teachers should integrate play in mathematics teaching, and should provide children with a variety of teaching and learning materials. This material should include manipulatives of different forms, sizes and colours, a different property (heavy, light, long, short, big, small), so that children can sort, classify and compare in the ECCE setting. Children will be able to recognise the use of these objects in and around their environment while they are playing, mainly in mathematical play-based activities.

Lee, Wongkamalasai, Thomson, Jasien and Rubin (2020:1495) argue that, in order to know and understand play or play-based learning, teachers should create a playful

environment where children will enjoy and participate fully in meaningful mathematical play activities. This engagement will enrich children's natural interest in a play-based learning and trigger their curiosity and imagination, as this forms part of learning in the ECCE setting. Reikerås (2020:706) postulates that high-quality work with mathematics in the ECCE setting is very important, especially for children with a weak foundation in mathematics and, as a result, teachers should focus on play-based mathematics to enhance children's skills. However, adult engagement in play-based learning has an important role in determining the mathematics learning outcome of children. Examples of activities are parents guiding their children to make correct measurements when they cook together, and asking the child to count the number of forks need for a family dinner. Furthermore, identifying the shapes of signs when riding in a vehicle could be a good strategy to mediate play-based mathematics at home (Ramani & Scalise, 2020:79). Farrugia (2021:21) discovered another type of play that leads to the development of mathematical play concepts, called play with loose parts, which involves a set of items like pebbles, acorns, shells, tree slices, corks, ice-cream sticks and blocks, which could amuse children while developing their mathematics skills while they are playing. Lee et al. (2020:1497) suggest that, in order to engage in new and inclusive mathematics practices, it is important to understand how to use play's unique ability to engage children in boundary testing as a meaning-making activity that is central to participating in mathematical play practices in the ECCE setting.

This implies that young children's mathematics education can be undertaken through play, which can be mediated by using different types of toys and self-made teaching and learning materials and by allowing children to initiate play-based mathematics. During interaction between the practitioner and the child, intergrade teaching and learning moments should be gradually introduced, considering the child's context. Blending mathematics and play for learning in the ECCE setting gives children joy and amusement, which is important for promoting lifelong learning.

The rural context of ECCE provisioning

Research reports that investing in ECE yields exceptional returns and has become a powerful equaliser that ensures that socially disadvantaged children are not left behind at the start of teaching and learning (Rao et al., 2021:1). Rurality is defined by Chigbu (2013:851) as a condition of place-based homeliness that is shared by people with

common ancestry or heritage. Maher and Prescott (2017:521) concur and define a rural area as any city or town outside a metropolitan area, and a remote setting as any town of less than 5 000 people. Baxter, Gray and Hayes (2010:6) point out that access to services and education aspirations is generally more limited in rural areas than in urban areas. This results in children who reside and attend ECCE centres situated in cities performing better in mathematical play education than those in ECCE settings in remote areas. Du Plessis and Mestry (2019:2) explain that parents who live in rural contexts are not involved in supporting their children at home with mathematical play, as parents generally have a lower level of education. Additionally, low levels of education do not add value to support for education in the early years, which has a negative impact on teaching and learning in rural ECCE setting.

Scholars indicate that more ECD centres have been constructed in rural and urban areas in response to demands for such provision (Yizengaw & Tessega, 2020). There has also been an increase in the sustainability of ECCE programmes in both the global and local context. Crouch, King, Olefir, Saeki and Savrimootoo, (2020:161) report that poor access to pre-primary programmes in rural areas result in many children lacking a solid foundation in mathematical play in the ECCE setting. According to Baxter et al. (2010:4) the geographic remoteness of some areas in which children live can have a significant impact on their learning experiences. Rao et al. (2021:1) articulate that large disparities remain a challenge, in both developed and developing countries, concerning the provisioning of ECCE in rural areas, which deprives minority groups of opportunities to reach their potential through quality education. It appears that the parents of children who reside in rural areas cannot afford to enrol them for early care and education and, instead, prefer to have them attend home-care centres, which permit educators to have lower levels of educational attainment (Williams & Mann, 2011:10).

Harris (2021:4) indicates that some non-formal programmes and other school activities in rural areas take place under trees or in forests. Whalley and Barbour (2020:105) found that, in rural schools, principals have high expectations about learning at schools and in the community. At the same time, they found themselves teaching multi-grade classes but receiving little support for administrative duties (Whalley & Barbour, 2020:106). This is not peculiar to principals, as teachers at rural schools are expected to do multi-grade teaching, that is, they are required to teach different subjects and

different grades in one classroom. However, this practice has serious consequences for teachers in terms of lesson planning as well as meeting teaching timelines for multi-graded classrooms (Du Plessis & Mestry, 2019: 2). In addition to this challenge, teachers in rural schools may lack competency, may lack time due to a high workload, lack resources, and lack direct supervision per grade or learner (Shareefa, 2021:179). Shareefa also reports that teachers are supposed to assess learners in their grades under the same roof, which inhibits them from reflecting and applying different strategies to mediate and scaffold learning accordingly.

These challenges are not faced by teachers alone. In rural ECCE centres, children find themselves being taught mathematics concepts far beyond their understanding. Worldwide, studies reveal a remarkable discrepancy between children's outcomes in urban and remote rural settings (Preston & Barnes, 2017:6). Morris, Slater, Fitzgerald, Lummis and Van Etten (2019:2) corroborate this claim, by saying that children in remote settings generally underachieve compared to their counterparts in urban areas. Shareefa (2021:1) argues that using differentiated instruction in a rural ECCE setting may help all learners. Azano, Callahan, Brodersen and Caughey (2017:66) agree with Shareefa, by saying that learners are not a homogenous group – they differ from one another at a specific level of background knowledge, understanding, interest and learning profile. Instead, Azano et al. (2017:67) advocate for play-based learning, which grounds learning in local phenomena and children's lived experiences by responding to the rural education setting. DBE (2014:4) adds to these statements by indicating that teaching and learning should be based on the principle of universal access to ECE and support.

Furthermore, learners in rural areas must travel long distances to reach school and, after school, back home. Living in isolated areas aggravates difficulties relating to access to educational services, such as libraries, and recreational opportunities that could enhance children's performance and ensure they are on par with their peers in urban areas (Iruka, DeKraai, Walther, Sheridan & Abdel-Monem, 2020:17). It can be argued that adequate support from the socio-cultural world of the child could minimise the disparity that exists between rural and urban ECCE settings, and promote the understanding of practitioners' lived mathematical play practice in the ECCE setting.

2.4 REVIEW OF RELATED EMPIRICAL STUDIES ON PLAY AND MATHEMATICAL PLAY PRACTICES

An emphasis on play and mathematical play practice is not new in ECE. Scholars indicate how important play and mathematical play in this area are. In this section, various studies and related literature on play and mathematical play practices in ECCE will be discussed. Firstly, will I review empirical studies on the importance of play and mathematical play in ECCE learning. Secondly, I will discuss perceptions on lived play practices among ECCE practitioners. Thirdly, the constraints that impede practitioners from adopting play practices in ECCE mathematics learning will be discussed. Fourthly, I will explore strategies that can be used to improve play and mathematical play in the ECCE setting. Then implications of the reviewed literature for the study will be outlined and concluded by a summary of the chapter.

2.4.1 Importance of play in ECCE mathematics learning

Numerous studies have explored the importance of play, as well its effectiveness for mathematics learning in the ECCE setting. Li and Disney (2021:3) studied young children's mathematical problem-solving and thinking, and found that play is an important source of development that affects children's mathematics learning in the early years positively. The study also found that play motivates young children to learn and achieve meaningful experiences through repeating play patterns (Li & Disney, 2021:1). Irvin (2017:2) conducted a study on the importance of play in ECD and found that play is a key element of child development; it provides necessary skills that include the ability to do problem-solving with a peer group, and enhances language skills in the early years. The same study found that, through play, a child's mental abilities is strengthened and memory and vocabulary, as well as storytelling skills, are improved. Manzano-León et al. (2021:1) found that playful learning is a pedagogical methodology that is vital for children's active social engagement, and provides a free environment for children to learn while playing. UNICEF (2018:6) reveals that play is an essential strategy for teaching and learning, which is relevant throughout the childhood period and beyond. The study conducted by Ogunyemi and Ragpot (2016:4) in Nigeria and South Africa found that play-based learning provides children with relevant competencies to balance their work while learning and playing in indoor and outdoor areas. Das, Akter and Chowdhury (2021:1696) carried out a study on the use of play,

and found that play and play-based learning activities improve children's state of emotion, mind, intelligence, and social skills.

2.4.1.1 Play as a motivational strategy for teaching and learning

In the ECE setting, play is regarded as a key motivational strategy for teaching and learning, and adopting play and mathematical play is an integral part of learning. Learning programmes that include play motivate and encourage children to be keen to learn. For practitioners in the ECCE setting, it is important to align the curriculum of young children with developmentally approved practices that motivate them to want to play and learn more, and to be eager to be involved in activities that include play-based learning and mathematical play. In this section, play as a motivational strategy for teaching and learning will be explored.

When children play, they tend to learn and become interested and motivated to play. Zosh et al. (2017:5) found that learning through play motivates and empowers children to become creative, engaged, lifelong learners. In a study on learning through play as a pedagogy for achieving learning outcomes in ECD mathematics, Vogt, Hauser, Stebler, Rechsteiner and Urech (2018:592) found that play was a powerful vehicle for motivating children to learn in kindergarten. A study by Anderson and Thomas (2021:60) on engaging children with play-based learning, discovered that play-based learning programmes were an important tool for intrinsically motivating learners during learning tasks. Play motivates and keeps young children on task until they complete the task. Stirling (2014:1) explains that intrinsic motivation comes from within, and extrinsic motivation comes in the form of an external stimulus or reward; in this case, the outcomes are achieved through engaging in play-based learning.

Irvin (2017:7) found that, when play is child-driven, children will practice decision-making skills, move at their own pace, become interested and eager to learn, and ultimately engage fully in their choice of play. Zosh et al. (2017:17) found that children are intrinsically motivated to play, which makes it fertile ground for teaching, learning and the development of new, constructed skills. Yin, Keung and Tam (2021:555) studied the implementation of play-based learning in Kindergarten and found that the support of the principal contributed positively to and motivated teachers' intention to implement play-based learning, directly and indirectly, through the trust of colleagues and teacher self-efficacy. Irvin (2017:5) reveals that, when young children play, they

become motivated and acquire new skills and experiences and learn to take turns, and exhibit other social behaviour, such as respect and self are. Murtagh, Sawalma and Martin (2022:2) found that play fosters intrinsic and extrinsic motivation, which provides immediate gratification, maximises enjoyment and playfulness, and is fun for children; thus, play improves academic performance in mathematical play-based learning. O'Neil and Amorose (2021:1) studied mother/father supporting structures, which is a centred approach in youth sport, and reveal that parents play an important role in motivating their children to play sports. Winand, Ng and Byers (2020:2) found that, if children lack motivation to participate in play activities, they are unable to sustain their physical activities.

Gusmuliana and Apriana (2021:532) found that motivation is one of factors that influence individuals to learn. They also suggest role play as a good strategy that can motivate learners to learn and talk in the classroom. O'Sullivan and Ring (2018:273) researched play as learning, and its implications for educators and parents, and found that, through play, learners can be motivated to learn without fear of failure; this ignites creativity and problem-solving. A study conducted by Winand et al. (2020:2) reveals that it is vital that different types of motivation to play should be explored as interventions for promoting and sustaining play-based activities during learning and teaching. Boncquet, Soenens, Verschueren, Lavrijsen, Flamant and Vansteenkiste (2020:1) found that motivation is a powerful tool for influencing children's performance in mathematical play-based learning. The same study found that, when school tasks and activities are not intrinsically motivating, students can still be autonomously motivated if they realise the importance of their schoolwork.

2.4.1.2 Play as a tool for language skills enhancement

At a very young age, children start to learn language through their interaction with family members when they play games or are involved in play activities. During play-based learning in the ECCE setting, children use conversation as a tool to enhance language skills. Exposing children to different types of play and play-based learning activities strengthens their language, science, mathematics and literacy skills – skills they will use in formal schooling. This section will discuss play as a tool for language skills enhancement.

A study undertaken by Beatson (2020:2) on play-based environments and language development found that, when children play, they use existing language, which helps them to acquire the skills to manage an inquiry-based conversation during learning. Quinn, Donnelly and Kidd (2018:123) found that play is a driving force for development, by providing a context in which children can acquire a range of cognitive skills, including language. Excell and Linington (2015:191), in a study on teaching in Grade R, found that play is important for children's adaptation to the social world, and helps them to learn cultural norms and grow their language skills. Nyah (2021:4288), in their Nigerian study on family involvement in play and literacy of preschool children, found that learning through play is spontaneous and an easy way to encourage children to express themselves and improve their literacy.

According to Wasik and Jacobi-Vessels (2017:769), during interaction between the child and a parent, the child's language, especially vocabulary, can be scaffolded through different types of play-based activities, which gives the child the opportunity to learn and develop language skills. Bustamante, Greenfield and Nayfeld (2018:1) studied early childhood and engineering, by investigating what happens when children play and design patterns with blocks during engineering and science learning. They found that children make observations and predictions, engage in collaborative conversations with teachers and their peers, and can answer questions and give engineering and scientific solutions to their problems. A study by Bagiatia and Evangelou (2016:70) found that, through play, children learn mathematics language and science, and the get opportunity to use words and discuss concepts, such as units, size, balance, and lighter than and heavier than, during their discussions.

Bukala and Ijeoma (2020:19) found that, during play, children learn language and words naturally, such as sieve, funnel, pour, and flow, to express themselves and increase their vocabularies. A study conducted by Reikerås (2020:706) on the relationship between play skills and mathematics skills of toddlers, reveals that toddlers frequently use non-verbal communication through a gestures and facial expression during mathematical play. Harris and Petersen (2017:2) carried out research on mathematics talk at home and mathematics skills at preschool, and found that play at home is vital for giving children opportunities to engage in mathematics talk in everyday routines. This happens when children interact with their family

members during cooking, playing with money or buying and selling goods, which stimulates children's conceptual and procedural understanding of mathematics.

2.4.1.3 Play as a child-centred approach to holistic development

Play has been found to be an effective child-centred approach to fostering holistic development of children's learning and development in the ECCE setting. Studies have found that play contributes holistically to learning and development of the child through facilitation by adults and the use of adequate learning and support material.

According to John (2017:347), a holistic education is a method that focuses on preparing students to meet any challenges they may face in life or in their academic careers. Research conducted by Cloete (2015:47) found that it is through play that children learn to accomplish problem-solving, gain self-discipline, creativity, concentration, independence, and cooperation skills, learn perseverance, and acquire a sense of wonder, which are the components of holistic development. Bagiati and Evangelou (2016:69) conducted research on practicing engineering while using building blocks and found that play is an approach that develops children academically, socially, artistically, creatively, and cognitively, which benefits children's cognitive development in a specific way.

Bukola and Ijeoma (2021:17) undertook a study on water and sand play, and found that this type of play is more than just fun for children. Water and sand play are a good approach to fostering holistic development of the preschool child. According to Bose and Seetso (2016:2), play and games have been found to be closely related to childhood, and provide children with opportunities to be creative and develop their abstract thinking, which contributes to holistic development. Taylor and Boyer (2020:127) conducted a case study on play-based learning in the Kindergarten classroom. Their case study found that play-based learning is not only important for discovery and construction of new ideas. Play-based learning is a child-centred approach, and is important for developing children's academic, social, emotional, cognitive, physical, and motor skills. Research undertaken by Khusnidakhon (2021:74) found that the combination of these skills helps children to adjust and transit better, and lead to better performance, not only in school, but in the future. This study recommends that, in order to enhance the holistic skills of children, it is important for teachers to have strong academic backgrounds and competencies in the area of play

as learning, as a core component of teaching and learning in the ECCE setting. According to Bose and Seetso (2016:2), teachers can interact naturally with children through play during teaching and learning in the early childhood classroom.

Pascoe and Brennan (2017:76) found that learning through play is important for children's sense of exploration, relationships, and interaction with others, including parents and teachers. Parker and Thomsen (2019:8) conducted a study and found that play fosters foundational skills and knowledge that support literacy, mathematics, and science learning. Brown (2020:43) found that play and mathematical play are important activities that rest at the interaction of teachers' knowledge of child development and learning. This study also indicates that teachers have to consider what is individually and culturally appropriate for each child, as doing so will promote optimal learning practices in the ECCE setting.

2.4.1.4 Play as an essential strategy for teaching and learning

Play is an approach to learning that is gaining momentum in ECD. Play is an essential strategy for learning that assists children to learn while they are interacting with others and their learning environment. This strategy involves the child in different forms of play under the guidance of the practitioner or another adult. This section will discuss how several researchers view play as an essential strategy for teaching and learning.

Zosh et al. (2017:12) undertook a study on learning through play. They found that play is a natural way of learning that helps individuals of a species to learn to grow and thrive. The same study reveals that, through playful learning, a child can benefit from many forms of play, which include physical games, construction play with blocks, boardgames, pretend play and engaging in role play. Őçal (2021:2) indicates that, during mathematical play, children undertake measuring, sorting, matching, building, patterning, comparing and counting, discover shapes, volume and areas with toys, paint and solve problems. All these mathematical play-based activities contribute to strategies that are essential for teaching and learning in the ECCE setting (Őçal, 2021:2). Aksoy and Aksoy (2017:105) found that children enjoy block play for learning mathematics concepts, such as geometry, measuring and sizing different blocks, and determining numbers and colours; these activities contribute to the cognitive development of the child. Bukalo and Ijeama (2020:19) reveal that it is not only toys that can promote mathematics education in the ECCE setting; children can also learn

through water and sand play, they can practise eye-hand coordination, and develop skills for sharing, cooperation, learn to show respect, become socialised, learn team spirit, love, appreciation and acceptance.

Gold et al. (2021:52) found that the trajectory of informal mathematics knowledge is rooted in social constructivism theory. Children form an early understanding of concepts through experiences with objects. Čelik (2017:114); Dağli and Dauğlioğlu (2017:124) found that, during play, mathematics is encountered in the field of life; mathematics can be observed in the child who has connected with mathematical concepts and leads to their developmental interest and thinking skills in the area of mathematics. Bhuda and Marumo (2021:119) add that incorporating games into mathematics teaching and learning gives children opportunities to utilise mathematics principles for problem-solving, to develop an effective interest in mathematics, and foster the notion that learning is enjoyable.

In a study conducted by Monkevičienė, Stankevičienė, Autukevičienė and Jonilienė (2017:290), on pedagogical strategies that improve children's play-based learning in Germany, they found that there are some strategies that are essential for promotion of children's learning. One of these is a strategy that involves the initiation and promotion of joint attention, which emphasises what the child has learnt (Monkevičienė et al., 2017:297). Another strategy encourages children to learn from peers. Children learn from each other through a variety of playful interactions, which create opportunities to learn (Monkevičienė et al. 2017:299). The same study reveals another teaching strategy, that is, promotion of communicative teacher–children encounters in play. In this strategy, there is interaction between the teacher and children; the teacher expands and enriches children's authentic play through dialogue. The last strategy of Monkevičienė et al. (2017:301) promotes reflection on play-based learning. In this strategy, children reflect on what they have learned through play, how they understood it, and what was difficult. Intervention is used to address challenges children face, to develop their metacognitive abilities and to regulate teaching and development. The research conducted by Daubert, Ramani, and Rubin (2018:2) report that these types of strategies of play help children to learn the skills they need for social interaction with others, their teaching and learning environment, and the world beyond.

A study conducted by Gold et al. (2021:51) found that playing with blocks provides a means for creative expression, social cooperation and flexibility, and is a multimodal variety of learning. Bustamante et al. (2018:2) reveals that, during block play in early childhood, science and engineering can capture children's attention and stimulate organic opportunities for educators to scaffold children while they exercise critical domain-general learning skills. This study also discovered that, during science and engineering play experiences, children recognise patterns, engage in measurement, comparison, sorting and organising, which are critical for early mathematics (Bustamante et al., 2018:4).

Research on learning through play by Zosh et al. (2017:5) reveals that playful experiences offer a unique, supportive and rich learning environment in early childhood. In Botswana, Bose and Seetso (2016:2) studied science and mathematics games in mathematics teaching in preschools, and found that rhymes and songs are important activities that spice up learning and are fun. This could be included as part of the pleasure-giving play activities that the children indulge in themselves. Nleya and Ndlovu (2020:113) studied mathematics concepts in pre-colonial Africa and found a learner-centred approach to teaching mathematics to be relevant and practical. Mathematics is a useful subject, and is applicable to everyday life.

2.4.2 Perceptions of lived play practices of ECCE practitioners

Worldwide, developing the child is the most common responsibility of teachers. Ducusin and Dy (2016:2) carried out research in the Philippines on parental perceptions of the importance of play in early childhood. They found that parental knowledge and perceptions of play are determined by their attitudes, experiences and expectations about the role they should play in providing their children with opportunities for learning through play. Consequently, perceptions, attitudes, beliefs can influence their lived practices when they use play as a universal tool for holistic learner development. In this section, practitioners' perceptions, attitudes and beliefs, as components that might influence their engagement with learners during play-based learning activities in the ECCE setting, will be considered.

2.4.2.1 Perceptions on the use of play as a positive teaching technique

Edwards (2017:19) conducted a study on perspectives on play in the early childhood classroom and found that child-oriented play may be a promising, effective, and inexpensive means of promoting positive development for preschool children. Furthermore, Edwards (2017:19) revealed that beliefs, perceptions, and dispositions of teachers have a direct influence on the method in which play is delivered in their personal classrooms. Okobah (2018:19) found perception is a process through which individuals receive and process information from their context, and that perception plays a major role in influencing the quality of teaching and the level of interaction between teachers and children. Okobah reports that parents' perceptions of ECCE programmes are based on their views on the quality of teaching staff, and on the level of interaction between teachers and children. Greaves (2018:90) found that human perception exists at the nexus of the a priori conditions of time and space, and they determine the fundamental form and content of all perceptions. Shimpi, Paik, Wanerman, Johnson, and Duh (2014:75) investigated Chinese trainee ECE educators' perceptions of Western-style, child-centred ECE praxis in China. They found that beliefs and perceptions about children's learning can affect their learning outcomes. Therefore, teachers are encouraged to follow the interests of and actively engage in activities alongside children (Shimpi et al., 2015:75).

A study in Ghana by Kekesi, Donkor, Aburampah and Torkonyo (2020:504) found that early childhood teachers in Afadjato South District had positive perceptions about the use of play as a teaching technique and its positive influence on children's learning. In Malaysia, Puteh (2013:79) investigated preschool teachers' perceptions regarding the use of a play-based teaching approach, and found that teachers were positive about play-based approaches at school; they believed that children liked be actively involved in play. However, in the same study, the researcher was unsure about using a play-based approach in Malaysian preschool classrooms. Ramstetter and Murray (2017:18) investigated the time for play at school, and realised the benefit of recess, or break, as a positive technique for teaching and learning. The same study found that teachers perceive break or recess as a time for peer interaction, during which children communicate and cooperate. This offers the children experiences and opportunities for developing social and emotional skills (Murray & Ramstetter, 2017:18).

Edwards (2017:47) studied whether play, as we perceive it, is an integral part of the daily classroom routine. Participants disclosed that play is an essential aspect of school readiness and an indispensable part of the daily classroom routine. A study by Onditi, Otengah and Odongo (2018:62), on the influence of teachers' perceptions of play-based activities, found that early childhood educators believed that play-based activities contributed to children's development. However, teachers had insufficient time to engage children in effective play for growth and development in the preschool setting.

2.4.2.2 Teachers' attitudes towards and beliefs on play-based learning in the ECCE context

Teachers' attitudes and beliefs about the use of play, and their understanding of play as a developmentally appropriate practice in the ECCE context, has been investigated. For a teacher to understand how to implement play-based learning in the classroom, they should know what the most appropriate instructional play involves. Play can only be effective if teachers' attitudes and beliefs about play-based teaching are positive, and if they give children the opportunity to learn and experience different play skills, both under the guidance of the teacher, and through child-initiated play-based activities.

In the ECCE context, teachers' attitudes and beliefs play a major role in play-based learning. Turk (2015:64) studied parents' beliefs and attitudes about a play curriculum and found that parents', teachers' and practitioners' involvement in childhood development is not limited to childrearing. They reflect upon, plan, assess the decisions they make about their children, and set targets, objectives or goals that they feel their children should achieve through effective play methods, and all these activities are influenced by their beliefs and attitudes. A qualitative study by Faas, Wu, and Geiger (2017:75) on the importance of play in ECE found that there are different perspectives on learning through play, which results in many interpretations and discussions around play and cultural settings in different contexts. Studies on learning through play conducted by Vogt et. al. (2018:591) and Monkevičienė et al. (2017:291) investigated strategies that are essential for promoting children's learning. They found that teachers' positive attitudes and beliefs are necessary for engaging children in a

play-based mathematics, as an appropriate pedagogical strategy for teaching and learning in the ECCE setting.

Much has been said about play and the role of practitioners in implementing play-based learning. However, the study undertaken by Rengel (2014:116) on preschool teachers' attitudes towards play, found that preschool teachers have a passive and reserved role in children's role play. Teachers were indecisive about whether they should participate in play if their participation is not child-directed (Rengel, 2014:116). The same study found that teachers believe that children should be supervised, but also given the freedom to engage in free play activities of their choice (Rengel 2014:117). Spencer, Joshi, Branje, Murray, Kirk, and Stone (2021:213) studied early childhood educators' perceptions of risky play in an outdoor loose-parts intervention. They found that, when teachers integrated loose parts, or open-ended unstructured material, into a play environment, they believed it brought about positive social behaviours, stimulated creativity and improved problem-solving, confidence and resilience. Another study on visual arts pedagogy in an early childhood context (Lindsay, 2020:80) found that educators' self-efficacy beliefs influence their pedagogical choices. The choices are influenced by personal experiences and subject-domain beliefs teachers develop during teaching and learning in the childhood context. The same research found that, if educators lack confidence, knowledge and skills on visual arts learning and engagement as part of play-based learning, it may result in a negative cycle for the next generation of children, and deny them access to visual languages as part of learning in the early years.

2.4.2.3 Perceptions on the use of play as a universal tool for holistic learner development

In the ECCE setting, play is regarded as an important and universal tool that develops children holistically. It is through play that the child starts to interact with others and the world around them. Through play, children acquire essential knowledge and skills that are necessary to explore, discover, negotiate, solve problems, and lead, and construct knowledge.

UNICEF (2018:8) found play to be natural tool for developing skills across all development domains, including motor, cognitive and social skills that are vital for the holistic development of a child. A study on what facilitates knowledge on implementing

play-based learning, conducted by Yin et al. (2021:555), investigated what facilitated kindergarten teachers' intention to implement play-based learning. They found play-based learning to be a key strategy of ECE. The same study reveals that teachers with highly efficacious beliefs showed higher active intention in implementing play-based learning as a universal tool to achieve the child's total development.

A qualitative study of teachers' views on increasing recess time found that play is widely understood to promote social behaviour, physical activity and attentiveness in the class (Baum, Patton & Rhea, 2020:506). Pendergast, Lieberman-Betz and Vail (2017:45) state that these interrelated factors relate to individual professional teaching attitudes and beliefs towards mathematics and science education in the ECCE setting. Even though play is perceived as a universal tool for holistic development that lays a foundation for learning in early years, Meilanie and Syamsiatin (2020:17) found that there is still a disagreement about what human actions are included in the play activity, why children engage in it and how it impacts holistic learning and development in the ECCE setting.

2.4.3 Constraints to adopting play practices in ECCE mathematics learning

Since the introduction of ECCE from a global to a local context, it has become clear that children in this setting need to be engaged in stimulating activities that support their mathematics education. This is not always the case, as practitioners in this area face constraints that impede them from adopting play-based learning practices. These constraints are challenges that emanate from teachers' inadequate qualifications, the absence of teacher development programmes, a lack of pedagogical knowledge on play-based practices, a lack of content knowledge on play-based practices, and shortages of teaching and learning resources. These constraints are complicated further by a shortage of ECCE personnel in rural contexts, unrealistic practitioner–learner ratios and classroom overcrowding, a lack of parental support, and the rural context itself.

2.4.3.1 Constraints emanating from inadequate qualifications

In the ECCE setting, it is important for practitioners to have received training as child workers. This global requirement relates to practitioners' qualifications, which is one of the most important predictors of child being developed holistically. Therefore, it is

vital that practitioners obtain adequate qualifications for engaging children in mathematical play learning in the ECCE setting. This section will look at some most common challenges confronting ECCE in the classroom, as well as practitioners' career development. Gray and Ryan (2016:191) conducted a study entitled, *Aistear vis-à-vis the Primary Curriculum: The Experiences of Early Years Teachers in Ireland*, and found that there is shortage of qualified staff to enact play and play-based learning, and that practitioners lack knowledge of how children learn and play. However, Minimansurovich (2014:447) conducted a study in Russia on improving teachers' qualifications, and found that conditions for teachers' qualifications have changed through training and professional retraining. Discussions indicate that teachers should improve their qualifications to meet the required standards.

Kalimullin (2014:448) investigated improving the qualifications of teachers at Kazan Federal university in Russia, and reveals that there is no perfect monitoring system to check practitioners' competencies or to facilitate and formalise their qualifications. Shareefa, Moosa, Zin, Abdullah and Jawawi (2019:222) studied teachers' perceptions on differentiated instruction to determine if experience, qualifications, and challenges matter. They found that teachers' experience, qualifications, and their potential to teach, influence their perceptions of differentiated learning, as they lack the expertise to apply this strategy in teaching and learning in early years, particularly regarding mathematical play. Holmqvist (2019:1) also refers to a shortage of qualified teachers, which is a global challenge in both Sweden and South Africa. Both countries endorse the right to a good quality education for all without limitation, which is hard to achieve if governments cannot provide schools with qualified teachers. In South Africa, Atmore, Van Niekerk, and Ashley-Cooper (2012:133) recommend that teachers obtain adequate qualification by enrolling in TVET (Technical and Vocational Education and Training) colleges, or ECD non-profit organisations that are accredited by the Education, Training and Development Practices Sector Education and Training Authority (ETDP-SETA) for basic qualifications. Aubrey (2017:6) reveals that the qualification requirements for voluntary and home-based sector professionals are more flexible, and qualifications of staff range from appropriate NQF training for non-governmental organisation (NGO) staff to unqualified staff at charity-based preschools.

2.4.3.2 Lack of teacher development programmes for ECCE practitioners

Even though practitioners' practices of play-based mathematics are regarded as a priority in the ECCE setting, their professional development is essential and needs to be addressed to improve their mathematics practices in this area. However, most teachers in ECCE settings still use more traditional ways of teaching.

Smets and Struyven (2020:17) conducted a study in Belgium, *A Teachers' Professional Development Programme to implement Differentiated Instruction in Secondary Education: How Far do Teachers Reach?* They found that many teachers are unable to teach in diverse classrooms, as they are not professionally trained to teach in such classrooms. Beltramo (2017:327) undertook a study on developing adaptive teaching practices through participation in cogenerative dialogues in the Unites States. He found it is vital to provide teachers with learning opportunities that resonate with students' contexts, as well as their individual interests, social needs and learning preferences. Currently, practitioners are not doing this, due to inadequate professional development. Kalimullin (2014:447) found that the content of courses and professional retraining of teachers is outdated, mainly because few institutions are able to develop tailormade programmes for teachers to implement teaching and learning effectively.

Setoromo and Hadebe-Ndlovu (2020:7) found that teachers possessed limited knowledge and understanding of the professional domains that each teacher should possess to teach effectively in any discipline. Daries (2017:16) undertook a study on funds of knowledge and practice of early childhood teachers in disadvantaged contexts, and found that teachers who work with the birth-to-four-year age group have very few opportunities for professional growth and career-pathing. The same study found that, in the absence of accredited training and qualifications, teachers continuing training up to NQF levels 1 to 4, which is not adequate for teaching and learning in the ECCE setting. Chuta (2018:57) conducted a study on district-level policy and practice for supporting instructional leadership by school principals in South Africa, and found that teacher development is a focal point in teaching and learning. Teacher development should be done in such a way that it deepens teachers' knowledge of subjects, sharpens skills, and updates their personal development.

2.4.3.3 Lack of content knowledge of play-based practices

Practitioners' knowledge and their practices relating to the way young children learn and develop in the ECCE setting is of paramount importance, not only for children's development, but also for teaching and learning in ECE. Teachers' pedagogical and content knowledge should be incorporated as part of play-based practices, so that they can engage children in mathematics education.

According to Shulman (1987), in addition to possessing skills, teachers need to model good practice, as well as be thoughtful of their teaching. Shulman (1987:8), in a study of knowledge and teaching, and the foundations of reform, found that pedagogical knowledge, and not mere pedagogy, is the category most likely to distinguish the understanding of a content specialist. Furthermore, knowledge of the following stipulated professional domains is required for effective teaching: subject matter content knowledge, pedagogical knowledge, curriculum knowledge, general education pedagogical knowledge, knowledge of learners, knowledge of education context and knowledge of educational aims, goals, and purpose. For the purposes of this study, I will only discuss content knowledge and pedagogical knowledge in relation to play-based mathematics.

Content knowledge, as explained by Shulman (1987:9), includes an understanding of what makes the learning of specific topics easy or difficult; this involves the conceptions and preconceptions that students of different ages and backgrounds bring with them to the learning of the most frequently taught topics and lessons. Additionally, he reveals that teachers' knowledge is one of the most critical factors that affect teachers' classroom behaviours and their students' success. Furthermore, teachers must possess and demonstrate adequate content knowledge. This means that they should know the facts, concepts, principles, and structure of the subject they teach, which, in the ECCE context, is generally inadequate. Knowledge of how every young child learns and develops play-based mathematics should have accumulated through the guidance knowledge of the teacher. Delgado-Rebolledo and Zakaryan (2020:567) found that the focus in teaching mathematics in the ECCE setting should be strongly directed to teachers' content knowledge. In addition, teachers' understanding of mathematics education and their reflection on their mathematics education teaching practices should assist them to understand the subject and to implement the

knowledge. Shulman (1986) recommends that teachers continuously renew their content knowledge to ensure that they are on par with new developments in teaching and learning – this is key to their professional development.

2.4.3.4 Lack of pedagogical knowledge of play-based practices

The development of each practitioner in the ECCE setting should be rooted in their pedagogical content knowledge in their everyday lives. During play-based learning, teachers' practices will be determined, to a large extent, by the depth of their pedagogical content knowledge.

Shulman (1987) describes pedagogical content knowledge as a special combination of content and pedagogy that is uniquely constructed by teachers; it is a 'special' type of an educator's professional knowing and understanding. It comprises integrated knowledge that represents teachers' accumulated wisdom with respect to their teaching practice: pedagogy, students, subject matter, and the curriculum. Beltramo (2017:327) claims that, for teachers to develop adaptability to their pedagogical knowledge, they need a strong base of pedagogical content knowledge, a vision of ideal teaching, and, especially, a deep understanding of and familiarity with their students. Brown (2020:43) states that play and mathematical play are important aspects of teaching that rest at the interaction of teachers' knowledge of child development and learning. This knowledge includes knowing what is appropriate for each child individually, and what is culturally appropriate for each child. This appropriateness promotes optimal developmentally appropriate practices and learning in the ECCE setting.

Faas et al. (2017:77) found that adult support of children's play, and accompanying it with child-appropriate pedagogical education processes, are important elements of pedagogy. Furthermore, the situational aspects of 'free play' should be adopted by the practitioner and passed on the children (e.g., in terms of basic experiences). It should also involve assigning specific activities (e.g., finger games, exercise games, gardening), didactic materials, and specific, defined topics and content, which, in most cases, rarely occurs, due to practitioners in the ECCE setting lacking pedagogical knowledge.

2.4.3.5 Constraints caused by shortages of teaching and learning resources

Shortcomings in learning and teaching in the ECCE setting are a major concern worldwide. For effective teaching to take place, teaching and learning resources should be available. In addition to learning resources, appropriate teacher practice and knowledge of how to incorporate teaching and learning resources in play-based learning are required. Teachers must know and understand how children should handle, use, and manipulate teaching and learning resources. Regrettably, both the resources and knowledge on how to use them to support effective teaching and learning in the classroom are sometimes lacking.

The study undertaken by Kotzé (2017:69) on social gradients, ECE and schools performing above the demographic expectation reveals schools are faced with a lack of infrastructure, and a lack of support from municipalities, which compromised learning environments, and lead to poor staff performance. In Norway, Irvin (2019:190) investigated the availability of materials needed for a conducive teaching and learning environment in ECEC. Irvin (2019:7) found that children learn best in an environment that allows them to explore, discover and play with the aid of teaching and learning materials. Panthi and Belbase (2017:3) studied teaching and learning issues in mathematics in Nepal, and found that there is shortage of teaching aids and textbooks, too little time for students to master the content, a lack of clear objectives for teaching and learning in mathematics, and generally, a shortage of hands-on resources for classroom practice.

Teachers are struggling to combine theory with practice. Mubashar et al. (2020:624) found that practitioners' implementation of the ECCE curriculum is ignored by policymakers in education. Consequently, factors that affect teaching practices in the ECCE setting are not studied in depth in relation to the South African ECCE context, and consequently, issues relating to shortages of teaching and learning material in the ECCE setting are not addressed. Wolf et al. (2018:20) studied measuring and predicting process quality in Ghanaian pre-primary classrooms using the Teacher Instructional Practices and Processes System. They found that provisioning of quality teaching and learning resources is the most important component of teaching and learning. Additionally, the structural elements of the classroom, such as the availability of books and desks, classroom lighting and classroom size, are important for

improving outcomes and promoting quality education in the early years. Setlalentoa (2014:227) analysed “scaffolding from not knowing to knowing numbers and counting, and classroom conversations in the teaching of numeracy”. She found that using items as concrete representations of a concept were effective in assisting learners to comprehend mathematical play concepts. She reports that indications of knowledge of number processing by learners can help an educator to identify at-risk learners early on. This information can guide appropriate educational interventions at schools and recommend teacher training levels, if enough learning materials is available.

2.4.3.6 Shortage of ECCE personnel in rural contexts

Although rural communities are found in both developed and developing countries, globally and locally, teachers are still struggling to understand what rurality entails and how it affects teaching and learning in the ECCE setting. For instance, one of the factors that impedes teaching and learning in rural communities is a shortage of personnel for teaching and learning in the ECCE phase.

Williams and Mann (2011:8) undertook a study on ECE in rural communities, specifically regarding access and quality issues. The authors found that remoteness presents unique challenges to families with young children, and indicate that one of the greatest challenges facing rural communities is the availability of a trained ECE workforce. de Hoyos and Green (2011:2), Du Plessis and Mestry (2019:2) found that there is a shortage of staff in remote rural communities, that attracting and retaining teachers was difficult, and that means to maintain professional learning, so that teachers kept up with new curriculum developments, were lacking.

Lamb and Glover (2014:69) compared educational disadvantages of urban and regional and rural schools, and found that smaller schools have fewer teachers and potentially less flexibility. The same study found that rural and regional schools tended to have a more expensive teacher profile, as they had a higher proportion of principal class and leading teachers relative to all teachers. The proportion of ‘accomplished’ and ‘graduate’ teachers declines with remoteness, and they make up only 31 per cent of all teachers in remote areas. The authors also found that small schools tended to have fewer resources, were often unable to employ specialist staff or offer specialist subjects and programmes, and instead used composite multigrade classes and programmes, which provide few opportunities for children to learn and explore

mathematics education. Another major challenge, revealed by Kirsten (2017:9), is that migration leads to practitioners with the right qualifications moving from caring for children from birth to 4 years old, to teaching Grade R, because of the higher status, higher salary, and better service conditions. Atmore (2013:133) found that immigration, and unqualified or untrained practitioners create a substantial problem for the development of children between the ages of 0 and 4 in the rural context, as practitioners prefer to teach at urban schools, which pay better salaries than schools in rural areas do.

2.4.3.7 Constraints emanating from the practitioner–learner ratio and overcrowding in classrooms

Many schools across the globe have overcrowded classrooms. This constraint, of a large number of learners in one classroom, makes teaching difficult. In overcrowded classrooms, teachers face challenges relating to stimulating and maintaining learners' interest, and teaching thinking and problem-solving skills to leaners.

Echazarra and Radinger (2019:25) found that rural schools have more children per classroom, or higher student–teacher ratios. Khan and Iqbal (2012:10163) found that overcrowding has a negative impact on teachers, by causing stress and, in addition, affecting students' performance and leading to problems with classroom discipline, causing behavioural problems, and poor health for both teachers and children, which leads to poor performance of the school at large. Olaleye, Ajayi, Oyebola and Ajayi (2017:112) studied the impact of overcrowded classrooms on the academic performance of students in selected public secondary schools in Nigeria. They found that the physical environment, excessive class size and overcrowding have a negative effect on teaching methods as well as materials, as children have to share class space and teaching and learning resources.

Panthi and Belbase (2017:2) found that, in most schools in Nepal, classrooms were not big enough to accommodate a large group of learners, which resulted in overcrowding and affected teaching and learning and seating arrangements in the classroom. Teachers who are used to groups of 20 to 30 learners might find a group of 50 to be rather threatening. Others may be relieved when they have only 50 learners. This indicates that overcrowding in rural and urban areas is a challenge, though it varies according to context and meaning.

Bowne, Magnuson, Schindler, Duncan, and Yoshikawa (2017:408) conducted a meta-analysis of class sizes and ratios in ECE programmes. They found that lower child–teacher ratios, whether due to more teachers or smaller class sizes, may make it easier for teachers to interact individually with every student and to monitor classroom activity. Even in a large class, an additional teacher may make it easier for the teachers to work together to observe all activities, facilitate teacher interventions or to provide support when necessary, and provide more opportunities for one or two teachers to work individually with children, while another supervises the classroom.

Motsepe, Maluleke and Cross (2019:93) found that consensus on ideal class size is lacking, and varies according to context, hence, this study refers to both the concept of teacher–learner ratio, and overcrowding, which it takes to refer to the same phenomenon. According to the DBE (2014), the official class size for public schools in South Africa requires a 30:1 learner–teacher ratio, and anything beyond that constitutes an overcrowded classroom. West and Meier (2020:2) published *Overcrowded classrooms –The Achilles heel of South African education* and reveal that overcrowded classrooms are the result of a shortage of teachers, a lack of school infrastructure, and a large number of poorly resourced no-fee schools (quintiles 1 to 3).

2.4.3.8 Lack of parental support

Parents play a major role in their children's education, by participating and being involved in the day-to-day running of schools, by providing leadership and governance and supporting their children with their schoolwork at home. However, due to a lack of supporting structures and proper guidance on how parents can be involved in schools and render academic support to their children at home, parents lack knowledge on how to assist their children at home and how can they be involved in school governance.

Policies and mandates with titles such as No Child Left Behind and Race to the Top (Vikram, 2021:3; Akiba & Howard, 2021:2) indicate that families and teachers should play major role in the education and development of children by using play-based learning as a valuable tool for promoting effective collaboration. This recommendation is confirmed by Frosch, Schoppe-Sullivan, and O'Banion (2021:45) in study on parental influence on children's education and children's success at school. The

author found that parents often fail to realise the extent of their influence on the education of their children. Tefera (2018:186) argues that, because EC is a critical period in the development of growth of children, there is a need to train parents to provide ECE interventions through home programmes.

Baker (2013:3) studied parental involvement during the foundational K-6 years of education, school choice, and student academic achievement, and found that the idea that parental involvement has a positive influence on students' academic achievement is so instinctively appealing that society, in general, and educators, in particular, consider parental involvement to be an important ingredient of a remedy for many educational problems. Goshin, Dubrov, Kosaretsky and Grigoryev (2021:907) investigated strategies of parental involvement in adolescents' education and extracurricular activities. They found that it is important for teachers to train parents to create a supportive home environment that is conducive and stimulating and assists children to solve emerging problems relating to teaching and learning, by assisting children with homework and to cope with their daily school encounters. According to Frosch et al. (2021:46) it appears that many parents have limited opportunities to get involved and lack an interest in the school's activities, as they feel intimidated because of their educational backgrounds and socio-economic status, which could lead to miscommunication between the school and home. The DBE (2011:15) reports that a lack of parental involvement has a huge impact on leaners' performance in the early years. Hence, it is vital that parents participate in the education of their children. This gap between parents and schools is widening, because parents do not have the skills they need, and are expecting the school to guide them on how to be involved in their children's education.

2.4.3.9 The rural context as a constraint for quality ECCE provisioning

Dissatisfactory standards of education, especially in rural communities, have been prevalent since the conception of ECCE provisioning across the globe. In global as well as local contexts, the right of every person to receive a good quality education is being recognised more and more.

A study conducted by Echazarra, and Radinger (2019:32) found that ECEC, which has been shown to improve the opportunities of disadvantaged children, is another instance where rural families have fewer opportunities than urban families. This

shortcoming of the rural environment can be related to several factors on the supply and demand side, such as provision of quality ECCE programmes at reasonable distance and cost, occupational patterns, and family structure.

The quality of teaching and learning in the ECCE setting is greatly influenced by the environment, and by the teacher who works with young children in that setting. Meilanie and Syamsiatin (2020:16) report that consensus has been reached on the quality of ECCE services that all children should receive, especially those in marginalised communities confronted by social or economic disparities; they should have access to universal, good quality teaching and learning in their environment.

A safe environment for children plays an important role in their physical development. The policy for ECD outlines important factors that influence the safety of the learning environment (DBE, 2015:26). These include the need for adequate space for all the children to play outside, fencing around the playground, safe play equipment, qualified practitioners who supervise children, and clean facilities (Kirsten, 2017:15). Kirsten (2017:8) posits that investigation of ECD provision in rural and urban contexts in the North West province of South Africa revealed that training does not always guarantee quality provisioning in ECD centres, for a number of reasons: a lack of proficient instruction during training, a lack of support to help the students with work, a lack of knowledge on the side of teachers, and a lack of follow-up support after teacher training is complete to ensure constant implementation. Fourie (2014:510) states that, without the necessary support and commitment of parents, practitioners at ECD centres struggle to use their knowledge and skills in their practice to help children develop. These practitioners need support from parents and caregivers to help children develop, especially children who struggle to keep up with the norms and standards of the class.

Motsepe et al. (2019:94) report that countries such as the United States, Malaysia, Iran, Ghana, Mali, Cambodia, El Salvador, and Uganda continue to face enormous rurality challenges. It is difficult to maintain quality standards in rural schools that are comparable to those of urban schools.

Even though quality education is a right for every person, schools in rural communities still neglect play as a strategy to enhance teaching and learning in the early years. Lamb and Glover (2014: 69) reveal that rural schools provide fewer opportunities for

professional development for teachers, have greater difficulty recruiting and retaining teachers, provide less support for special needs students and offer fewer options for teachers' professional development. Furthermore, they found that learners in rural communities find themselves in less secure and more marginalised positions after completing their basic education, which includes ECCE (Lamb & Glover, 2014: 68). Matyjas (2012:90) found that the situation of rural learners could have negative effects on them, to the extent that they develop low sense of personal worth and self-esteem.

Mbabvu (2017:7) studied political socialisation and its implications in a rural setting in South Africa, in a village in Limpopo province. Mbabvu found that people who reside in rural areas are less exposed to technology, the media and other developmental resources than those who live in urban areas. Thus, the political socialisation of rural people is likely to be different from that of people in urban environments. Mbabvu (2017:13) criticises the quality of teaching and learning in rural areas in Unites States of America, as it is largely focused on white, middle class, urban and suburban American children in only one historical period, and neglects poor and marginalised communities. Chrzanowska (2009:52) confirms that education in rural environments, as presented above, have fewer educational opportunities for children from these environments, mainly because of economic, social, and cultural factors, and differences in the development of the educational system, which is biased against rural communities in remote areas.

2.4.4 Strategies for improving play and mathematical play practices in the ECCE setting

This section will deal with strategies practitioners can use to enhance their lived mathematical play practices in ECCE settings. Four common global strategies that can be used to address challenges will be discussed, to assist practitioners to ingrate play-based learning in mathematics education in the early years, namely ensuring that practitioners possess adequate qualifications for ECCE, provisioning professional development programmes, allocating sufficient resources for teaching in ECCE, and encouraging parental support and engagement in schools.

2.4.4.1 Improving the qualifications of ECCE practitioners

ECCE practitioners take care of young children from birth to four years old. They teach young children basic skills for holistic development in the ECCE setting. Teachers in this area need to have a strong communication, interpersonal, organisation and problem-solving skills. The education and training provided by ECCE requires a specialised qualification for working with children of that age, and one that takes the type of the environment that teachers will be teaching in, into consideration.

Manning, Garvis, Fleming, and Wong (2017:13) undertook a study on the relationship between teacher qualifications and the quality of an ECEC environment. They found that teachers with adequate qualifications are positively related to improvements in supporting child development, language reasoning, providing variety of social experiences for children and creating a warm, friendly environment for interaction during teaching and learning. Moreover, they found that the quality of education is closely linked to the level of staff qualifications, which may indicate that it is important that teachers who work with children possess qualifications higher than secondary education. Elwick, Osgood, Robertson, Sakr and Wilson (2018:522) conducted a study on quality early childhood qualifications and training policy in England. They found that the qualification pathways pursued by workers in ECE has altered the landscape of practitioners in the ECCE setting. A study by Mubashar et al. (2020:623) recommends that teacher training institutions for ECCE teachers should introduce curricula that are activity-based, and that schools provide better learning conditions in ECCE centres.

Shareefa et al. (2019:216) undertook a study on teachers' perceptions of differentiated instructions, they found that experience and qualification of teachers matter when implementing teaching and learning for diverse learners. They found that the teachers of today are familiar with a wider range of educational practices and, thus, they think more positively about their instructional approaches and practices, as they are adequately qualified. In Nigeria, Salami (2016:76) studied ECE policies and practice for sustainability and that found experienced primary school teachers who had obtained National Certificates in Education, and those who had undertaken Primary Education Studies to be employed in pre-primary settings, had adequate qualifications for that setting. Lesotho's Ministry of Education and Training [MoET] (2019:10) developed a framework for an Education, Training, and Innovation Fund. The

framework was found to be helpful for supporting the implementation of the Lesotho Qualification Framework, as well as basic education, which includes technical and vocational education and training, academic, professional development awards, and part-qualifications (MoET, 2019:10). Maundeni (2013:58) studied ECCE in Botswana, “a necessity that is accessible to few children”, and analysed the ECCE policy and programming in Botswana that was commissioned to identify and intensify training and professional development of unqualified teachers, especially in community schools. The Project for Inclusive ECCE revealed that there is a need to implement a professional programme that will assist universities to implement and design a Level 5 diploma and a Level 7 degree in ECCE to cater for educators who are responsible for the education of children from birth to four years old (Maundeni, 2013:55).

In an endeavour to improve qualifications of ECCE practitioners, South Africa implemented the Project for inclusive Early Childhood Care and Education (PIECCE) in collaboration with the European Union, the RSA DHET and the United Nations (PIECCE, 2018:2). This project was led by the University of South Africa (Unisa), in partnership with Ntataise and False Bay College. Other universities in the consortium were the Universities of Pretoria, the Witwatersrand, Fort Hare, the Free State and KwaZulu-Natal, Walter Sisulu University, Cape Peninsula University of Technology, North West University, and the University of the Western Cape, which joined in 2019. The project was designed to support professionalisation of the ECCE sector, in order to increase access to qualifications for ECCE educators working with children from birth to four years, standardise educator training, and help to align occupational and professional qualification pathways through an ECCE Diploma and Bachelor of Education. Most university are engaged in this mandate (PIECCE, 2018:2). The DBE (2011:13) designed an integrated strategic planning framework for teacher education and development in South Africa. This framework is used as an intervention, in partnership with NGOs and TVET colleges, to capacitate ECD teachers to achieve adequate levels of qualification.

2.4.4.2 Providing professional development programmes

Teacher professional development and capacity development have been identified as priorities in the teaching and learning environment. These programmes have been found vital for fostering teachers’ personal development and improving the way

teachers impart content and pedagogical knowledge effectively in their classrooms. Mubashar et al. (2020:623) undertook a study on factors that affect teachers' practices in implementing the ECCE curriculum in public schools. They found that teacher training institutions for ECCE should include curriculum activities that are play-based, to ensure teachers can use play to ensure children learn effectively. Another finding by the same authors is that schools must improve learning conditions in ECCE centres that provide teachers with continuous professional development to enable them to cope with emerging modern demands (Mubashar et al., 2020:6243).

Another study, by McKoy (2020:4) on the perspectives of ECE training colleges on the role of play, found that, to address teachers' professional development, it is necessary to identify a faculty or technical college that will ensure that practitioners understand the role of integrating play in their lesson plans, and its implementation in the ECCE setting. Totenhagen et al. (2016:586) undertook a study on retaining ECD practitioners, and a review of the empirical literature found that implementing incentive programmes (e.g., financial stipends and/or scholarships) for practitioners' professional development and retention encouraged them to enrol for college courses to enhance their professional development. The study by Kalimullin (2014:448) recommends that higher education institutions must be committed to improving the qualifications and professional development of teachers; they must provide a basic education and new content, so that teachers can acquire the required professional development.

Whilst research underlines the importance of early mathematics learning in Kindergarten, a study conducted Vogt et al. (2018:589), on learning through play, pedagogy and learning outcomes in early mathematics, found that, for practitioners to engage children in play-based learning, practitioners need effective and innovative approaches, as well as training programmes on play-based learning. Furthermore, Kindergarten educators could use a training programme for mathematics to ensure that mathematics competencies are explicitly fostered (Vogt et al., 2018:589). In response to teachers' need for more informed content knowledge and pedagogy, Sheridan and Wen (2021:100) evaluated an online early mathematics professional development programme. They found that more professional development opportunities are necessary for early childhood teachers, and that the quality of education programmes must be increased. Jabbarov (2020:2) undertook a study on

the role of training in the formation and development of future foreign language teachers. Social psychological training is a strategy that is organised in a special way, in which the individual needs of each participant is considered; as a result, the quality of individual practitioners plays an important role in teaching and learning.

Bose and Seetso (2016:2) conducted a study on science and mathematics teaching through local games in preschools in Botswana. They found that using an innovative, ground-breaking strategy that is more than a novelty should facilitate early understanding of, interest in and mastery of concepts; thus, should make science and mathematics teaching interesting, easy and enjoyable for young children in the ECCE setting. The South African national department of education (DoE,2011:2) designed the Integrated Strategic Planning Framework for Teacher Education and Development in collaboration with teacher unions and stakeholders, including higher education institutions. This framework assists with resourcing appropriate structures and modes of delivery of teacher development, to ensure that support is accessible to all teachers, including programmes provided by a variety of role players, such as teacher unions and teacher development institutes. In this framework, continuing professional development programmes and short courses, as well as different modes of delivery appropriate for different purposes and teachers, are allocated points for each training event endorsed by the South African Council for Educators, as motivation. Baloyi-Mothibeli, Ugwuanyi and Okeke (2021:238) explored Grade R teachers' mathematics curriculum practices, and strategies for improvement and implications for physics teaching. They recommend that integrated teacher development programmes should be implemented to enable teachers to be fully engaged in early mathematics lessons. Doing so will contribute to enhancing the teaching of physics in the early years (Baloyi-Mothibeli et al., 2021:238).

2.4.4.3 Allocation of sufficient resources for teaching in ECCE

Allocation and access to teaching and learning material is fundamental to teaching and learning, and a prerequisite for ensuring that there is equitable quality material for teaching and learning that promote lifelong opportunities for both teachers and children during teaching and learning.

Mubashar et al. (2020:624) studied factors affecting teachers' practices in the implementation of ECCE curriculum in public schools. They recommend that key

learning areas of ECCE centres are equipped with sufficient material, according to the strength of the class. In addition, school heads and management should conduct sessions for ECCE teachers to ensure that the document of the national curriculum for ECCE is incorporated in their lesson plans, to promote children's holistic development (Mubashar et al., 2020:623). Salami (2016:77) reveals that making facilities and resources available at public centres, and lowering school fees, will enable all Nigerian children to access affordable preschool centres and get a good quality education. Salami reports that many centres have the necessary resources – indoor and outdoor – however, the utilisation of these resources for the holistic development of children is poor. This is because teachers have not been trained to plan and deliver child-centred instructions. Bustamante, Green and Nayfeld (2018:7), in a study on early years science and engineering, found the multimodal learning process to be an effective strategy that enriched mathematics education for learners in the school setting. The study also reveals that mathematical ideas permeate children's play: in the block area, for example, young children spend a good deal of time determining which tower is higher than another. These activities create and expand knowledge of children in mathematical play-based learning (Bustamante et al., 2018:8). Airi (2019:10) undertook a study on provisioning of educational content to rural schools in Papua New Guinea that used a remote area community hotspot for education and a learning service. Airi found that providing resources for teaching via DVD or CD makes material accessible to both the teacher and the students.

A study conducted in Malawi (Zozie, 2020:7) recommends integrating e-learning technologies in conventional teaching and learning in the school and higher education system with scarce resources. Zozie found that e-learning as teaching and learning resource has the potential to supplement the traditional, face-to-face mode of delivery, that predominately uses module guides, even though e-learning materials are much cheaper to produce and distribute than paper-based modules. In addition, electronic content is much more interactive and responsive to users than printed modules are.

Botswana, in collaboration with the Swedish International Development Cooperation Agency (SIDA), initiated a project in which the University of Botswana presented workshops to improve teachers' knowledge base and children's engagement in mathematics and scientific experiences. Bose and Seetso (2016:6) found that preschool teachers did possess the necessary content knowledge, that is, knowledge

of science and mathematics concepts, however, they always taught mathematics and science by means of conventional methods, using traditional teaching aids to teach science and mathematics concepts inside and outside classrooms. Through the empowerment and support provided by the workshops, a resource book was developed and endorsed as a supplementary teaching material for Botswana ECE teachers. Additionally, for preschools, rhymes and songs are used during circle times with preschool children to illustrate the meaning of words through simple actions and finger movements (Bose & Seetso, 2016:2).

Khululekani is an NGO that aims to make a positive impact on the quality of education under the auspices of the NDA (2014-2015:32), which upgrades the standards of the ECD programme and practices by increasing access to material, resources and equipment that supports and extends children's active learning. The Ncebakazi Day Care Centre is another NGO that is supported by NDA, which provides toys and learning material to promote children's cognitive development. A stimulating learning environment in which children actively engage with a range of materials to ensure school-readiness, is also provided (NDA, 2014-2015:33). Meier et al. (2015:453) studied problems and prospects in ECE provisioning in Turkey and South Africa, and recommend strengthening institutional resources and provisioning education for children from birth to four-year-old, to build public awareness on the importance of ECD in rural communities.

2.4.4.4 Parental support and engagement at centres

Parents influence schools and schools influence parents. This collaboration is an essential aspect of education, including components of teaching and learning. It helps learners to increase their academic skills, self-esteem, positive attitudes and demonstrates desirable behaviour (Ruholt, Gore & Dukes, 2015:1). It is recommended that schools, families, and communities must work collaboratively to ensure the academic success and socio-emotional well-being of all learners while meeting the needs of the learner (Lewallen, Hunt, Potts-Datema, Zaza & Giles, 2015:743).

Arriagada, Perry, Rawlings, and Zumaeta (2018:14) conducted a study, titled *Promoting ECD through Combining Cash Transfers and Parenting Programs*. They identify three curricula that are most often used to inform the design of parenting programmes in developing countries. Firstly, is the Reach Up model, based on

Jamaica's home visit programme, which enhances parents' engagement with their children to promote cognitive stimulation activities (Arriagada *et.al.* 2018:14). The second model is the Care for Development model, designed by the World Health Organization and UNICEF as a guide to health workers and other community-level workers to provide parents with information and on how to provide social-emotional support to their children. Thirdly, the Learning Through Play model was developed in Canada to train parents with low levels of education on children's physical and mental development (Arriagada et al., 2018:14). Pablo, Erkhembayar and Davison (2021:3) studied father presence, father engagement, and child outcomes in Mongolia, and found that the involvement of mothers and fathers can engage children in a playful activity, though fathers have unique types of playful interaction. Such 'rough-and tumble' play and teasing interactions can be beneficial for child development.

Nyakundi, Nyagah, Kalai, and Munayi (2020:27) studied the influence of parental involvement on learning outcomes at public early childhood centres in Nairobi. They found that parental engagement provides essential support for school-going children, especially at early ages. They also reveal that parents are likely to identify the learning challenges of their children at an early age; children with special needs are likely to be recognised at in early childhood. Chikutuma (2013:180) studied the quality of ECD programmes at Harare primary schools in Zimbabwe. The author found the quality of ECD programmes could be promoted through parental involvement in voluntary services, and inviting parents to act as resource persons when certain concepts were taught (Chikutuma, 2013:180). Furthermore, the author found that another strategy is to hold awareness campaign for parents, so that they realise the value of their involvement as decision-makers on school committees (Chikutuma, 2013:180).

Baloyi-Mothibeli (2018:6) developed a strategy to improve professional curriculum practice for a Grade R mathematics class. The author reports that the South African government promulgated the South African Schools Act (1996) as a strategy to give a voice to parents, and to involve them in the education of their children. This parental involvement is not only about improving academic performance of children, but also to promote cultural beliefs that shape the child's social, emotional, and cognitive development (Baloyi-Mothibeli, 2018:6). A study by Mncanca and Okeke (2016:222), entitled *Positive Fatherhood: A Key Synergy for Functional ECE in South Africa*,

reports that the involvement of fathers in teaching and learning of their children have a positive effect, and children benefit the support from their families.

Hugo and Masalesa (2021:2) report that the out-of-school environment could influence the development of foundation phase learners' literacy skills, and that the young child's home represents the microsystem in Bronfenbrenner's ecological system's theory. This implies that the home is the place where a child's first and vital education takes place, because it involves close interactions with parents, siblings, other family members, neighbours and the nearby community. It involves daily activities and relationships that help to shape children's cognitive, social, moral, and emotional involvement, which all directly influence children's development.

2.5 IMPLICATIONS OF THE LITERATURE REVIEW FOR THE CURRENT STUDY

In reviewing practitioners' lived mathematical play practices in the ECCE setting, I explored the role of practitioners to facilitate mathematics education in the ECCE setting. It is vital that practitioners contextualise the ECCE setting as an area of child development where informal learning takes place through practitioners' mediation of play-based mathematics learning, with the possibility of scaffolding the learning so that children achieve the goals of this setting. Children must have opportunities to be creative and innovative while doing mathematical play in the ECCE setting. Numerous researchers emphasise that play takes place on a continuum; it is a vital strategy in the ECCE setting, and teachers must provide children with opportunities to learn, explore, discover, and solve mathematical play by themselves, and with the facilitation of practitioners.

During mathematical play education, practitioners must ensure that parents realise that they can play a beneficial role in the education of their children and how they can assist their children to learn through play and enhance their children's involvement in mathematical play at home. The literature review explored the role of policymakers and curriculum planners, including district and provincial officials, in developing and supporting the ECCE centres delegated to them. This study aimed to give guidance on how to engage children in mathematical play, especially for in-service students who are in the field of early childhood learning. Since ECCE settings differ in different contexts, involving other stakeholders in the study will contribute to effective

curriculum planning, implementation, and management in the ECCE sector. The implication is that mathematical play education might be possible in the ECCE setting through collaborative efforts to enhance and promote play-based learning in a child's early years, specifically, from birth to four years old.

2.6 CHAPTER SUMMARY

In this chapter, I presented a comprehensive literature review on practitioners' lived practices of and perceptions on, and the constraints that impede them from adopting play and mathematical play learning in the ECCE setting. Firstly, I provided an overview of the theory that informed the methodology and data analysis in the study. Secondly, I discussed the social constructivism theory of Lev Vygotsky, as the theoretical framework that guided the study and its related constructs. I interrogated other researchers and established what they reported about the phenomenon under study, their points of view and their insights regarding this study. In this way I was able to identify gaps that might exist and which could be addressed by this study.

The conceptual framework that describes the concept of mathematical play learning was diagrammatically represented and discussed in depth. I fused the discussions on mathematics learning in the ECCE context with the discourse on the concepts of play and mathematical play. Furthermore, the rural context of ECCE provisioning was analysed. I ensured that all the different components of the study were integrated, coherently and logically, in order to effectively address the research problem. In addition, I reviewed related empirical studies as reported by literature on the importance of play in ECCE mathematics learning, perceptions of lived play practices of ECCE practitioners, constraints related to adopting play practices in ECCE mathematics learning, and strategies to improve play and mathematical play practices in the ECCE setting. Chapter 3 will discuss the methodology used in this study.

CHAPTER 3
RESEARCH METHODOLOGY

3.1 INTRODUCTION

The previous chapter presented a detailed literature review from different cultural contexts. In this chapter, I will focus on explaining the research methodology that this study used. The sections to be discussed include the research paradigm, the research approach and the design of the study. Furthermore, the chapter will describe in detail the selection of participants, the study site and instruments for data collection. Additionally, the instrument credibility, triangulation and trustworthiness will be explained, as will the way they contribute to the data collection instruments of the study. Data collection procedures, indicating how data was collected and analysed in the study, will be clarified. The chapter will also address the issue of ethical considerations, as an important aspect of conducting research. Each of these research methodology components will be discussed in relation to its definition, contribution, value, as well as relevancy for this study. I will conclude with the summary of the chapter.

3.2 RESEARCH PARADIGM

The concept of a paradigm is somewhat contested, and described in many ways by various authors and in different contexts. For instance, Cohen, Manion and Morrison (2018:8) define a paradigm as a shared belief system, set of principles or way of looking at research phenomena. A paradigm informs the decision on which research approach the researcher should choose for the study (Creswell & Creswell, 2018:1). In other words, all research is guided by assumptions or beliefs about the world and what is perceived, what is real and what is true (Moyo, Modiba & Simwa, 2015:95).

In this study, I used an interpretivism research paradigm, as its fit well with the research approach that I chose, which is a qualitative approach. Interpretivism is a response to the dominance of positivism, and believes in the existence of multiple, socially constructed realities, that truth and reality are created, not discovered (Rehman & Alharthi, 2016:55). Interpretivists believe that the social world can only be understood

from the standpoint of the individuals who participate in the phenomenon that is being investigated. Furthermore, Cohen et al. (2018:17) say that there is an objective reality with different views in the classroom that can be observed through diverse frames. Interpretivists assume that it is difficult to study human beings with the natural sciences, in the same way that we study objects (Cohen et al., 2018:17). Unlike objects, human beings change continuously and the environment in which they find themselves constantly influences their behaviour (Du Plooy, 2019:33). Thus, it was important for me to be subjective during the study in describing the participants' social context and how it influences their environment.

In short, interpretivists emphasise that truth and knowledge are subjective and culturally and historically situated, and are based on people's experiences and their understanding of them. Therefore, people cannot be separated from their own values and beliefs, which inform the way they collect, interpret and analyse data (Ryan, 2018:8). Hence, in this study, I aligned myself with the interpretivist philosophy, as the paradigm that provided me with guidance on the phenomenon that I studied. Therefore, using an interpretivist paradigm enabled me to explore practitioners' mathematical play practice in their contexts and guided my understanding of their experiences. I also ensured that participants were not separated from their historical backgrounds and cultural roots. By doing so, I was able to respond to the problem in question and gained in-depth understanding of participants' social contexts in a diverse way. Additionally, I ensured that the research was conducted in participants' natural setting. I was able to spent time and engaged with participants so that I could interpret their lived practices in their environments (Pham, 2018:3). I considered foundational characteristics of interpretivism to assess and interpret generated data and attached it to the meaning (Tshabangu, 2015:40).

3.3 RESEARCH APPROACH

In this section, I will discuss the research approach I employed in the study. A research approach is a plan and the procedures that will be applied for the research, that span the steps from broad assumptions to detailed methods of data collection, analysis, and interpretation (Creswell & Creswell, 2018:3). In this study, I employed a qualitative research approach. This approach was used for the following reasons: It focuses on lived experiences in their natural setting, preserves the chronological flow, and

documents the events that lead to consequences (Tracy, 2019:7). According to Nardi (2018:18), investigating lived experiences refers to trying to understand events from the viewpoints of the people who are part of the events and to understand their experiences, instead of imposing another person's viewpoint. Doing so meant I had to listen to participants without influencing the findings of the study.

The qualitative approach was relevant to the study because it provided me with rich data that I collected during the fieldwork, which gave me insight into human behaviour in its social context (Devlin, 2018:196). A qualitative approach is flexible and provides the researcher with freedom in terms of structure and order, as it uses methods such as unstructured interviews, observations and secondary sources to collect data. These methods were based on information about the lived experiences of the participants in their natural setting, where I was able to have face-to-face contact with participants and gain an understanding of what their lived practices in the ECCE setting involved (Kumar, 2019:306). I was able to observe what participants do, what they produced and how they interacted, verbally and nonverbally, when they engaged children in play and mathematical play learning (Nardi, 2018:19).

This approach offered me more than snapshot; it gave me a full understanding of practitioners' lived mathematical play practices in their natural setting (Tracy, 2019:7). Because the qualitative approach relies on multiple data collection tools, which include interviews, observations, document analysis and field notes, as methods and measurement instruments, I was able generate rich data, which assisted me to investigate the phenomenon in question. I was able to spend time with the participants in their environment, to be close to them and to produce descriptive data, which I could present in the participants' own spoken and written words.

3.4 DESIGN OF THE STUDY

This section will discuss the research design, which served as a road map that I followed during the research journey to find answers to the research questions, as validly, objectively, accurately and economically as possible (Kumar, 2019:208). Different types of research design are appropriate for different types of research projects. For this study I employed phenomenology. According to Nieuwenhuis (2020:85), phenomenology focuses on the meaning that certain lived experiences hold for participants, and the researcher describes what experience means for the

participants. In this study, phenomenology assisted me to understand and describe the practitioners' lived mathematical play practices and their individual experiences in the ECCE setting (Creswell & Creswell, 2018:55).

For this study, the specific meanings of the term 'research design' as revealed by Kumar (2019:208) were helpful. Thus, this study attempted to gain information on the perspectives, perceptions and understanding of practitioners' lived mathematical play practices in the ECCE setting by identifying the meaning of perspectives, perceptions and understanding as understood by the practitioners. I tried to understand the participants' perceptions, thoughts, memories, imaginations, emotions, desires and bodily awareness. Therefore, phenomenological research is about producing thick descriptions of people's perspectives and analysing people's perceptions, stories, beliefs and memories, and their lived experiences in their natural settings (Dane, 2018:150). I chose phenomenology because it is a socially and culturally situated, as actions and interactions that interpret participants' situation (Marshall & Rossman, 2016:18). With this study, I attempted to get to know what participants have experienced, and how they experienced it, with the assumption that is it important to perceive people – individually or in a group – in order to understand their lived experiences (Brinkmann & Kvale, 2015:30).

Using phenomenology allowed me to acknowledge my preconditions and assumptions and to reflect, openly and continuously, on the influence these preconditions may have on the research process. Bracketing was still important, but less so, as my observations were validated by the participants' interpretation of their reality, as an additional source of data.

Both the participants and I played an active role in the interpretation process of the data (Neubauer, Witkop & Varpio, 2019:94). Since my intention was to gain a rich and complex understanding of experiences of practitioners in the three CBCs, and thus, I explored how they engaged with children in mathematical play in this setting. Phenomenology allowed me to be a key instrument, by personally collecting data using interviews, observation and journal notes. This was done according to the research ethics protocol stipulated by research ethics document of the University of the Free State.

3.5 RESEARCH SITE

This study was limited to Motheo District which is in Mangaung Municipality in the Free State. This district is predominantly urban and comprises Bloemfontein, Mangaung, Botshabelo and Thaba Nchu, Ladybrand and Dewetsdorp. For this study, I limited the scope to five Mangaung CBCs, registered with the DSD and owned by the community. These centres were in three selected informal settlements in Mangaung township. I focused on, at most, two centres in each informal settlement.

Most informal settlements are characterised by disadvantaged communities and this has a direct effect on how practitioners lived mathematical play practices in the ECCE setting. I chose these CBCs because I had established a good partnership with them and had provided training and support during the implementation of NCF for children from birth to four years old while I worked for the Free State DoE five years ago.

These CBCs were convenient, eligible and readily available in my proximity, which assisted me to avoid issues such as traveling expenses, excessive time requirements and accessibility that might have impacted the study negatively. However, I anticipated that I might encounter constraints, such as roadworks that might block me from accessing the centres, unavailability of participants at the time of my visits, and other contextual factors that might hamper my fieldwork. At that preparatory stage, I prepared myself for unforeseen circumstances that might occur, and made plans to mitigate such constrains. Figure 3.1 demonstrates where Mangaung township is situated in the Motheo District in the Free State of South Africa.

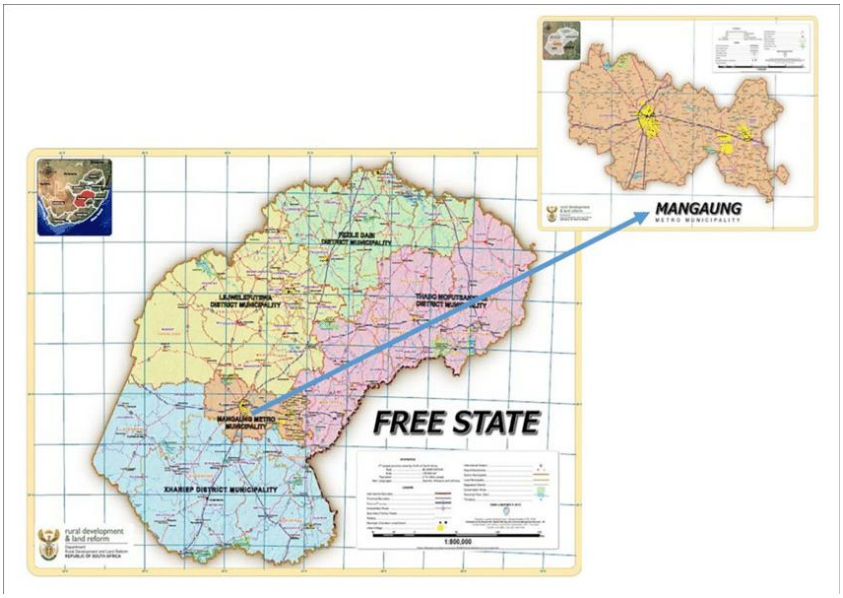


Figure 3.1: Adapted from Mangaung Municipality Map

Source: Google

3.6 PARTICIPANT SELECTION

I used purposeful sampling for the study. Purposeful sampling is often used for a small-scale sample data collection process and is suitable for studies that involve an in-depth study of human experience (Leavy, 2017:80; Maree & Pietersen, 2019:220). Participants were selected on purpose to represent a group because they were able to provide the relevant information for the study. The study sample comprised ten females who had obtained matric certificate qualification at least have three years' experience working in the ECCE setting. I selected five participants who had experience of teaching children who were three years old, and another five were selected because they had experience of teaching four-year-old children. The participants I selected were female because, historically, care-giving in the ECCE setting is an occupation for women. The ECCE setting was perceived as a child-care centre, rather than an educational space where women were expected to provide care and support for young children (Ayob, Christopher & Naidoo, 2020:2). Hence, in this study, all the participants were women. Furthermore, children are more likely to live with their mothers than with their fathers, which may contribute to typical patterns of gender roles or father absence due to severed relationships (Mncanca & Okeke, 2016:227). By involving female participants in the study, I could collect rich data from experienced mother figures in their natural setting.

My assumptions were that all the participants were willing to share their lived experiences of mathematical play-based learning in their natural setting, and that they were knowledgeable about the phenomenon under study. This enabled me to generate rich data, which assisted me to achieve the aim and objectives of the study. The Table 3.1 indicates how the selection of participants was done.

Table 3.1: Participant sample for research

Institution	Participant	Gender	Designation
Community-Based Site A	**P1**	Female	A practitioner responsible for teaching three-year-old children
	P2	Female	A practitioner responsible for teaching four-year-old children
Community-Based Site B	**P3**	Female	A practitioner responsible for teaching three-year-old children
	P4	Female	A practitioner responsible for teaching four-year-old children
Community-Based Site C	**P5**	Female	A practitioner responsible for teaching three-year-old children
	P6	Female	A practitioner responsible for teaching four-year-old children
Community-Based Site D	**P7**	Female	A practitioner responsible for teaching three-year-old children
	P8	Female	A practitioner responsible for teaching four-year-old children
Community-Based Site E	**P9**	Female	A practitioner responsible for teaching three-year-old children
	P10	Female	A practitioner responsible for teaching four-year-old children

3.7 INSTRUMENTS FOR DATA COLLECTION

In this section, I present information on the data collection instruments used in this study. During data collection, triangulation was employed, thus three instruments used: semi-structured interviews, observations and the researcher's journal, in which field notes were recorded. The field notes were written during visits to all the selected CBDs, in case I needed to follow up or need more clarity from the participants. The notes contained the results of observations, analysis, comments by the researcher and memos to self (Cohen et al., 2018:542). I ensured that I did not treat data collection and data analysis as separate processes, but as a cyclical process (Nieuwenhuis, 2020:95).

3.7.1 Observation

Since this research was quantitative, I observed participants closely to find out what they did, how they did it and what instructions were given verbally or non-verbally to children. This was followed by data collection, data analysis and data interpretation. Observation is one of the key tools for collecting data in qualitative research. It involves the act of noting a phenomenon in the field setting through the five senses of the observer, often with a note-taking instrument, and recording it for scientific purposes (Creswell & Poth, 2018:232). It is a purposeful, systematic and selective way of watching and listening to an interaction or phenomenon as it takes place (Kumar, 2019:217).

Observational studies can involve either a non-participant observer or a participant observer, and the observations can be either structured or unstructured (Creswell & Poth, 2018:308; Kumar, 2019:275). In this study, I observed as both a participant observer and a non-participant observer (Creswell & Poth, 2018:233). Being a participant observer was relevant to the study, as it enabled me to observe and view the children from different directions, depending on the nature and type of activities that took place in the ECCE classroom during my observation visit to a particular classroom. The activities were teacher-guided activities, child-initiated activities and free-play activities that took place in the indoor and the outdoor classroom environments. I also observed both small-group and whole-group activities closely in the indoor and outdoor areas. Where necessary, I took pictures of the children's work

without revealing their identities, and recorded audio-visual material after obtaining permission to do so from the participants (practitioners), while adhering strictly to the ethics protocol. In some instances, I played the role of non-participant-observer. During this type of observation, I sat at the back of the classroom while observing and taking notes of how the practitioner engaged children in mathematical play-based learning. Both methods of observation were suitable for the study and enabled me to engage with participants at any time. Sometimes, I sat on the carpet with children while the practitioner organised teacher-guided activities, such as morning ring, story time or any of the other routines that take place in the ECCE setting. Sometimes, I played the passive role of non-participant-observer when I was not directly involved but observed and listened from the distance in the natural setting (Kumar, 2019:275). My goal with this process was to get close to and observe reality as it occurred, and thereby obtain first-hand information on the phenomenon under study. This approach assisted me to keep a detailed record of everyday mathematical play-based practices. I used my journal during the process of observation and collected data accordingly.

To make this kind of decision to alternate the time of my visits to centres, it was useful for me to spend time in the setting on different days and at different times of the day, in order to get a sense of the variation in activities (Devlin, 2018:202). I made use of frequency and interval counts when I observed indoor and outdoor practices, perceptions, constraints and interventions relating to the way practitioners mediated teaching and learning during mathematical play-based learning in the ECCE classroom. I used an observation guide to record behaviours, how frequently I recorded that behaviour and the recording alternated during transition from one activity to another. The advantage of observation is that it was ideal for studying behaviour at the actual site, and it revealed unexpected findings in the context and in real time. Non-verbal data could also be observed and analysed.

To enhance the richness of the information collected through observation, I used interviews as another method for gathering information from the ten selected practitioners at the five selected ECCE centres. Journal entries were used continuously during all the data collection processes (Kumar, 2019:198). The interview process will be discussed in the next section.

3.7.2 Interviews

In the study, I used interviews because they are suitable for gathering information in more complex situations, useful for collecting in-depth information, and have a wide application. In interviews, information was supplemented and questions were explained (Kumar, 2019:108). Interviews are common ways of producing knowledge in the human and social sciences (Norman and Denzin (2018:998). For the purpose of the study, the semi structured interviews were conducted. Semi-structured interviews are generally open-ended that are few in number and intended to elicit views and opinions from participants (Creswell & Creswell, 2018:308). The unstructured interviews are flexible in terms of questions that the interviewer ask to the interviewee, explanation you provide, wording you use and the sequence in which you ask them (Kumar, 2019:622). Semi-structured interviews allowed me to interact face to face with the participants asked them questions and recorded all the information for analysis purposes. My choice for this method was to give the participants a freedom to choose any questions that they feel comfortable to respond to and I also had opportunity to formulate questions as raised issues on the spur of the moment

Through discussion and analysis, the interviews flowed freely and participants were not intimidated/controlled; questions and responses followed a flexible format and the interview guide developed by the researcher (Kumar, 2019:220). I used discussion to explore and probe for more information, where necessary. I gave the participants the opportunity to ask questions where they needed clarity. Additionally, I clarified the meaning of questions, uncovered practitioners' lived practices and gathered any information that was necessary to achieve the aim and objectives of the study. In order to obtain participants' opinions, information on their interests, attitudes, insights, experiences, thoughts, feelings, beliefs, motives, plans, knowledge levels and memories of practitioners lived mathematical play practice, in-depth interaction was employed. I gathered this information cautiously and respectfully in a non-discriminatory and non-threatening environment (Nardi, 2018:16).

The interviews elicited multiple understandings through interaction and construction of meaning amongst the practitioners who had been selected, it became clear that they had similar backgrounds and experiences. I encouraged participants to talk openly and ask questions whenever they wanted to do so, in order to uncover their dynamics,

rationales, values and opinions (Gaudet & Robert, 2018:92). This flexibility also helped me to follow up on questions and undertake the journey with the participants when they unfolded their lived mathematical play practices in the ECCE setting. I was able to address specific issues and gave participants the freedom to respond to specific questions they felt comfortable responding to. I ensured that I created room for the conversation to go in unexpected directions, by allowing considerable flexibility in scope and depth. Interviews took place face to face while observing COVID-19 protocols and the ethics protocol and I also allowed the centres enough time to prepare for my visits.

3.8 INSTRUMENT CREDIBILITY, TRIANGULATION AND TRUSTWORTHINESS

The criteria of reliability and validity are crucial for establishing trustworthiness of qualitative research. Credibility, dependability, confirmability and transferability are the four criteria used in pursuit of trustworthy and triangulated findings in this study (Creswell & Creswell, 2018:323).

3.8.1 Credibility

This study was conducted in such a way that the findings demonstrate credibility, that is, that the reader believes the findings. Credibility is the alternative to internal validity in quantitative research, in which the goal is to demonstrate that the study was conducted in such a manner that the research participants were accurately identified and described (Schurink, Schurink & Fouché, 2021:39).

I ensured confidence in the findings through peer debriefing, member checking, ensuring an audit trail and prolonged engagement. Peer debriefing is an important strategy to enhance consistency in qualitative studies. I involved my peers in this step, and gave them the opportunity to add new ideas and insights during the research process. I also gave them an opportunity to gain a general understanding of the study and provided opportunities to refine and discuss the research (Creswell & Creswell, 2018:324). Member checking involved returning transcripts of audio recordings to participants, so that they could verify the meaning that the researcher had assigned to their words. Doing so assisted the researcher to ensure the accuracy of the study's final report (Creswell & Creswell, 2018:324).

The researcher ensured an audit trail, thus, providing an overall objective assessment of the project from the beginning to the end of the study. By ensuring the accuracy of transcriptions, establishing a relationship between the research questions, data, and data analysis and ensuring that the findings, interpretations and conclusions are supported by the data ensured that the study responded to the problem in question (Creswell & Creswell, 2018:325). These steps assisted me to obtain a comprehensive understanding of the behaviour, values and social relationships of participants in their social contexts. The more extended the duration of my engagement with the participants at the ECCE centres, the more accurate I expected the findings to be.

3.8.2 Transferability

In the study I exercised discipline, flexibility, rigor and reliability to ensure that I applied transferability criteria. I did not generalise the data I collected, but attempted to make a connection between the study problem and the experiences of the participants, to ensure transferability. Transferability refers to the extent to which a study's findings can be applied in other contexts and is achieved through thick data descriptions, purposeful sampling and data saturation (Leavy, 2017:5). I ensured that data collection and analysis strategies were reported in detail, in order to provide a clear and accurate picture of the methods used in this study (Creswell & Creswell, 2018: 341). I ensured that all the important components of data collection were scrutinised by an external auditor with experience in qualitative research.

3.8.3 Dependability

One of the aspects of qualitative research is dependability, which is preferred over than reliability. Dependability refers to the stability of results – if the same thing is observed twice, and it gives the same outcomes (Kumar, 2019:352). To ensure data was consistent, I described how it was collected and recorded, coded and analysed. I described and precisely followed a clear and thoughtful research strategy and showed that each step was completed thoroughly and carefully throughout the research process, in order to demonstrate dependability.

3.8.4 Confirmability

The study contains no conflict of interest or bias. I involved the participants from the beginning to the end of data collection process and the collected data reflect the actual contributions of the participants. By doing so, I ensured confirmability. Confirmability refers to the degree to which the results can be confirmed by others, and having a self-critical attitude towards your own perceptions and being continuously reflexive (Kumar, 2019:352; Leavy, 2017:5). I guarded against influencing the data and, during the interpretation process, used external codes to check whether findings were consistent. Where necessary, direct quotations from informants were used.

3.8.5 Triangulation

To achieve triangulation in the study, different sources were used for data collection, namely semi-structured interviews, observations and journal notes. Triangulation is a commonly used strategy (Leavy, 2017:172) to minimise the risk of drawing conclusions from a single source of data. I used four methods of data collection sources, that is: literature, interviews, observation and journal entry, to verify and compare the data provided from the same participants.

3.9 DATA COLLECTION PROCEDURES

Creswell and Poth (2018:213) view data collection as a series of interrelated activities aimed at gathering good information to answer emerging questions from the researcher. The two main tools that were used in this study are the interview protocol and the observation guide, while a third, namely journal entries, was used continuously and concurrently with the other two.

3.9.1 Interview protocol

In the study, I used interviews as a tool for data collection. I employed face-to-face, semi-structured interviews. Norman and Denzin (2018:1000) define interviews as a verbal exchange in which an interviewer attempts to elicit information or expression of opinion or belief from another person or persons. During the process of interviews in this study, I interviewed 10 selected practitioners from five selected CBCs in three selected informal settlements in Mangaung township. In each of those five community-

based centres, I interviewed two practitioners, one responsible for three-year-old children and another one responsible for four-year-old children.

Since data in qualitative research is collected through a set of predetermined questions relating to the issue of enquiry, I developed an interview protocol to ensure desired coverage of the areas of enquiry and comparability of information across participants (Kumar, 2019:241). Although flexibility was maintained in terms of follow-up questions and the sequence in which questions were asked, the interview guide with predetermined questions was used to ensure the smooth running of the interview process (Roulston & Choi, 2018:239). This gave me the freedom to remain balanced and flexible during the interviews and to explore the phenomenon in question holistically and to obtain answers from the participants.

I developed an interview guide that I was used during the interview sessions to ensure that conversations remained focused. The interview protocol I developed is given in Table 3.2. Using it ensured consistency throughout the interview sessions (Patten & Newhart, 2018:161). During the interview sessions, I used a four-phase interview protocol model adapted from Castillo-Montoya (2016:812).

Table 3.2: Process to interview protocol refinement

Stage	Action
Stage 1	Ensure interview questions align with research questions and objectives of the study
Stage 2	Construct an inquiry-based conversation
Stage 3	Receive feedback on interview protocols

Source: Castillo-Montoya (2016:812)

3.9.2 Observation guide

during the observations, I was mainly concerned with observing mathematical play practices in the ECCE setting, as I explained in detail in point 3.7.1 above. I used an observation protocol that listed guiding questions in one column, and I recorded my observations in another column, as indicated in Table 3.3.

Table 3.3: Observation protocol

GUIDING QUESTION	MY OBSERVATION RECORD

3.10 DATA ANALYSIS PROCEDURES

The actual processing, analysis and interpretation of data took place after data had been gathered. I analysed the data using thematic analysis methods. This method enables me to break down the responses to the unstructured interview and to identify trends and themes within the responses. Coding was used to allow me to gain a deeper analysis into each response given by the respondents by connecting similar themes and categorising the feedback and be able to easily identify various connections between each category and theme (Du Plooy, 2019:39). The data collected from the semi-structured interviews, observation notes and journal entries were organised and coded and classified according to themes which were developed from the answers emerged from the questions (Nardi, 2019:19).

Data with common characteristics were grouped together in one folder and labelled according to batches, so that it was easy for me to retrieve during the transcription process. I handed over the recorded data to a trained transcriber (who agreed to keep the data confidential). I listened to each recording comparing it to the transcribed data for quality assurance. This process enabled me to understand and become familiar with individual participant's lived mathematical play practices. I understood their perceptions of the ECCE setting, and the constraints they encountered when they adopted play practices, including the interventions they employed in mathematical play-based learning in the ECCE setting to overcome those constraints.

The transcription, which included verbal and non-verbal cues during the interviews, was carefully considered. Thereafter, I took the time to reread the text and listen to the audio and visual recordings repeatedly while considering the aim and objectives of the study. I read through the transcription and contents of the journal used during the data collection process and reflected on the important and interesting points I had identified during data collection.

After I had transcribed and sorted the collected data, I divided it into folders with unique coding, using descriptive words so that it was easily accessible for reference at any point that I need clarity. I created three columns for reflection notes, interview, and codes. I ensured that each piece of information was written in the correct column and identified which information supported or contrasted with other information. After this process, I established themes: I grouped data according to common content that

shared same views, taking into consideration the research questions. The collected data was segmented into small chunks of meaning units, it was coded and synthesised in logical order that achieved the aim of the study. During analyses, I ensured that the social constructivism theory is also taken into consideration, as a lens guiding the study. I also watched out for patterns that were associated with practitioners' lived mathematical play practices. Furthermore, I observed how practitioners scaffolded and mediated the mathematical play practices in the ZPD – the ECCE setting – in the context of this study. At the end of this process, the information gathered from the data collection methods that include hard copies of data, recordings as well as the journal was securely kept in the strong room with the encrypted password known to me only. As a courtesy, I also promised to send the participated centres all copies of publications once the study had been completed and endorsed.

3.11 ETHICAL CONSIDERATIONS

The first ethical issue that I considered was to complete the necessary research ethics clearance application forms, through which I obtained permission to conduct the study from the University of the Free State. Secondly. I applied for permission from DSD, which was granted. To start with data collection at the selected CBCs, I requested permission from the principals or the centre managers before I interacted with the practitioners in the ECCE setting.

3.11.1 Gaining entry

Although I had already obtained permission to conduct the research, I negotiated entry into the study sites for reasons related to gatekeeping. The first task was to identify the key gatekeepers and develop a clear research plan for them (Eller, Gerber & Robinson, 2018:204). Having some prior knowledge of these individuals helped me to make initial contact telephonically or through email to secure appointments. The purpose of the initial contact with the gatekeepers was to arrange face-to-face meetings to build trust. It enabled the gatekeeper to find out who I am, and enabled them to ask questions about the research and the access required. Transparency was important at this juncture, and I showed the principals/centre managers copies of approved ethical clearance certificates from the University of the Free State and the permission letter to conduct a research at the CBCs from the DSD.

While I was in the field, I developed and maintained relationships with the participants (Cohen et al., 2018:312). This involved addressing interpersonal and practical issues to build participants' confidence in me. I established rapport, trust, sensitivity and discretion in handling people and issues, even if I disagreed or found something objectionable or repulsive. I was attentive and empathetic, discreet and sensitive about how long I could stay with the participants in the ECCE setting (Cohen et al., 2018:312).

I considered the after-effects of leaving the field and took care to ensure that nobody was harmed by the research, even if it was impossible to ensure that they benefited from it (Cohen et al., 2018:315). When the fieldwork was over, I showed gratitude to the participants for the time they had shared with me. I promised to keep in touch with participants and gatekeepers to inform them of the progress of the research. As a courtesy, I also promised to send them copies of publications once the study had been completed and endorsed.

3.11.2 Participants' rights

To ensure free and informed consent, I informed participants of the research objectives and the consequences of their participation, and I obtained confirmation that they understood the agreement and were willing to participate. I informed them that they could withdraw at any time, and I did not attempt to convince them to change their minds (Gaudet & Robert, 2018:130). Thus, participation was voluntary, which is an aspect of autonomy (Nardi, 2018:42).

3.11.3 Informed consent

During the briefing sessions, I explained the necessity for informed consent to participants before various parties signed and the process of data collection commenced. As a key principle of social research ethics, prospective research participants were given information as required so that they could make an informed decision about whether they wished to participate in the study (Patten & Newhart, 2018:35).

3.11.4 Confidentiality and anonymity

Through the principle of non-maleficence, I assured participants that confidentiality would be maintained (Nardi, 2018:38). I informed them that the audio recordings would be deleted as soon as the data had been transcribed. The voice recognition software that was used to transcribe audio data verbatim to electronic text-based was handed over to a trained transcriber (who also signed a confidentiality agreement) to transcribe the work.

I ensured anonymity by keeping the participants' identities secret (Devlin, 2018:118). I assumed it was for this reason that participants agreed to participate in the study.

3.11.5 Protection from harm

Central to ethical research conduct is the principle of "do no harm" to participants in the study. All research must be anchored on this principle to ensure the wellbeing of all those being served (Sefotho, 2021). I considered the interests and protection of participants as a priority. I took note of the characteristics of the research sample that was selected by assessing inclusion and exclusion through the principle of fairness. I identified all risks through the principle of non-maleficence (Strydom & Roestenburg, 2021:120).

Apart from risks and harm, I ensured that the study would be of benefit to all the participants, through the principle of beneficence. By engaging in evidence-based practices, the research participants had an obligation to promote the public good and to engage in beneficence too, and they fulfilled this obligation by producing new knowledge (Rach & Ufer, 2020:376).

3.11.6 Maintaining professionalism

Before I embarked on generating data for this research, I invited stakeholders involved in teaching and learning in the early years, specifically, ECCE centre mangers, ECCE associations, and forums for ECDE, and other professional bodies that the practitioner is registered with, to an information session. I introduced myself as a researcher and a lecturer at the University of the Free State. I adhered to ethics principles and a protocol that included, among other matters, privacy, anonymity, confidentiality, protection of participants' rights, and maintained professionalism throughout. A

detailed information session was conducted with the all the attendees; the consent form was explained and they were informed that the identity of participants would be preserved throughout the research. At the end of each interview session, I provided the participants with my full contact details, in case they need more information regarding the research.

3.11.7 Vulnerability of participants

During the research, I took safety measures into consideration and minimised risks that might be incurred by being involved in this study. I treated questions that directly affected participants with care, considered their emotions and minimised any physical or risk aspects that might negatively affect interactions or relationships or cause stigmatisation or discrimination of participants.

Gordon (2020:34) corroborates that risks to humans participating in research must be minimised, and that subjects must be offered additional protection from risks or hazardous situations. I provided full information and contact details of professional support that the participants might need during and after the research, in case participants felt emotionally drained or experienced any other issues that affected them during this process. I gave them my full details and also made them aware that, should they need to communicate with my supervisor regarding any issue arising from the study, they could do so without fear by using the contact information indicated in the invitation letter.

3.12 CHAPTER SUMMARY

In this chapter, I described the research design, research approach and paradigm of the study. I also described the study site and provided a brief description of the geographical area where the site is located. All the processes, including the procedures, were clearly articulated. I then described how the participants were selected, why they, specifically, were selected and the qualifications they had obtained. I discussed the instruments that were employed in data collection during fieldwork. I also reported on the matter of quality assurance of the instruments, which involved credibility, triangulation and trustworthiness. I discussed the process and procedures that I followed for collecting and analysing data. The important principles

of ethics that I applied during fieldwork and throughout the study were discussed in detail.

In Chapter 4, I will follow the process for data collection I discussed in Section 3.10. The next chapter will present the data generated in a systemic way. This will be followed by an analysis and interpretation of the data. Furthermore, the chapter will discuss findings in relation to the literature and the research problem.

CHAPTER 4
PRESENTATION AND ANALYSIS

4.1 INTRODUCTION

In the previous chapter, I discussed methodological instruments I employed to generate data that I anticipated would assist me to respond to the main research question: What are practitioners' lived mathematical play practices in early childhood care and education settings? I also described how each instrument process unfolded and the purpose for which it was used (*S*ection 3.7). This chapter will present the generated data in relation to the phenomenological study of practitioners' lived mathematical play practices in an ECCE setting in the Motheo District of the Free State province. This will be followed by analysis and interpretation of the data collected through semi-structured interviews with participants, observations in classrooms, and journal notes of the researcher, in order to respond to the primary research question. During data gathering, the following five themes were emerged to assist me in responding to the main research question:

1. Practitioners' lived mathematical play practices in the ECCE setting.
2. ECCE practitioners' preparedness in the mathematics play environment in CBCs.
3. Challenges impeding mathematical play practices in the ECCE environment.
4. Factors that may influence practitioners' mathematical play practices in a rural context.
5. Measures ensuring proper mathematical play practices in the ECCE setting.

Sub-themes were identified in the main themes of data collected during the semi-structured interviews, observations in the classroom, where photographs were taken, as well as the journal notes taken during investigation into practitioners' lived mathematical play practices in the ECCE setting.

For the purposes of anonymity, pseudonyms were used to identify practitioners; practitioners were coded from P1 to P10 (Table 3.1). Observations were done in the natural setting of participants in order understand and link their actions, roles and behaviour. During the observations, I took on the roles of participant observer and

non-participant observer (see Section 3.7.1), in order to gain deeper insight into my understanding of how practitioners engage children in mathematics education. Furthermore, photographs were taken in the indoor and the outdoor areas, as evidence of what transpired during practitioners' lived mathematical play practices in the ECCE setting. The following is a discussion of the information that emerged, presented as themes and sub-themes that respond to the phenomenon in question, and which are based on the objectives of the study.

4.2 DEMOGRAPHIC INFORMATION OF PARTICIPANTS

The study involved ten ECD practitioners in the Motheo District in the Mangaung Municipality of the Free State. All these practitioners were employed in CBCs in three selected informal settlements. Table 4.1 sets out the demographic data of the ten participants.

Table 4.1: Demographic details of participants

Participant	Community-Based Site	Gender	Age	Language Spoken at Work	Qualification	Years at the Centre
P1	**A**	Female	32	Sesotho	Grade 12	**3**
P2		Female	37	Sesotho	ECD Level 4	**5**
P3	**B**	Female	40	Setswana	ECD Level 4	**6**
P4		Female	45	Setswana	ECD Level 4	**8**
P5	**C**	Female	35	Sesotho	Grade 12	**4**
P6		Female	43	Sesotho	ECD Level 4	**8**
P7	**D**	Female	29	Setswana	B Ed	**1**
P8		Female	47	Sesotho	ECE Level 5	**6**
P9	**E**	Female	40	English	Grade 11	**7**
P10		Female	38	English	Grade 12	**6**

Table 4.1 shows that the CBCs were coded from A to E. Participants were all women, their ages ranged from 32 and 47 years, they had taught at a particular centre for between 1 and 8 years. Of the ten participants, five used Sesotho as language of learning and teaching, three used Setswana, and two practitioners used English. Although Sesotho and Setswana are the predominant languages in Mangaung township, some CBCs use English as the language of learning and teaching.

Regarding qualifications practitioners possessed, most practitioners had obtained qualifications on NQF Level 4 from TVET colleges and NGOs (DBE:2011:13). These qualifications were obtained through EDTP-SETA funding. The Level 4 qualification is equivalent to Grade 12. Participants who had completed Grade 12 indicated that they were dependent on financial assistance to enrol for further studies to improve their qualifications. One practitioner had completed Grade 11. Only one practitioner out of 10 had a B Ed degree in foundation phase.

4.3 OBJECTIVES OF THE STUDY

The following objectives guided the study:

1 Explore the current lived mathematical play practice of practitioners in the ECCE setting.
2 Analyse how ECCE practitioners prepare the mathematical play environment in community-based centres.
3 Examine the challenges faced in ensuring the proper mathematical play practices environment.
4 Explore the factors that may impact on practitioners' mathematical play practices in a rural context.
5 Determine the measures to ensure a proper mathematical play practices environment?

4.4 RESEARCH QUESTIONS

To answer the main research question: What are practitioners' lived mathematical play practices in early childhood care and education settings? the following sub-questions were addressed:

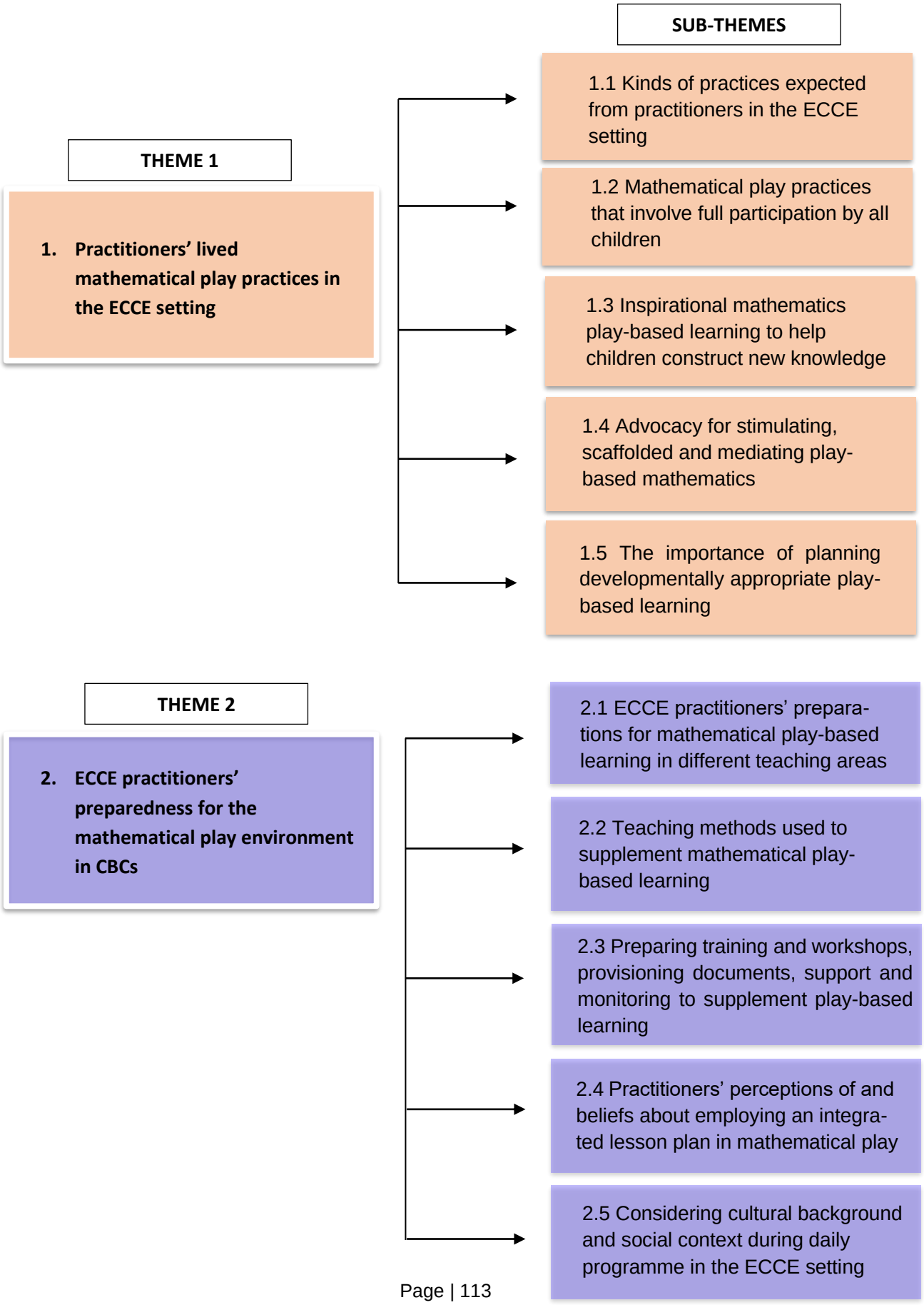
1. What are practitioners' lived mathematical play practices in an ECCE setting?
2. How do ECCE practitioners prepare the mathematical play environment in CBCs?
3. What are the challenges facing ensuring the proper mathematical play practices in this environment?
4. What factors influence practitioners' mathematical play practices in a rural context?

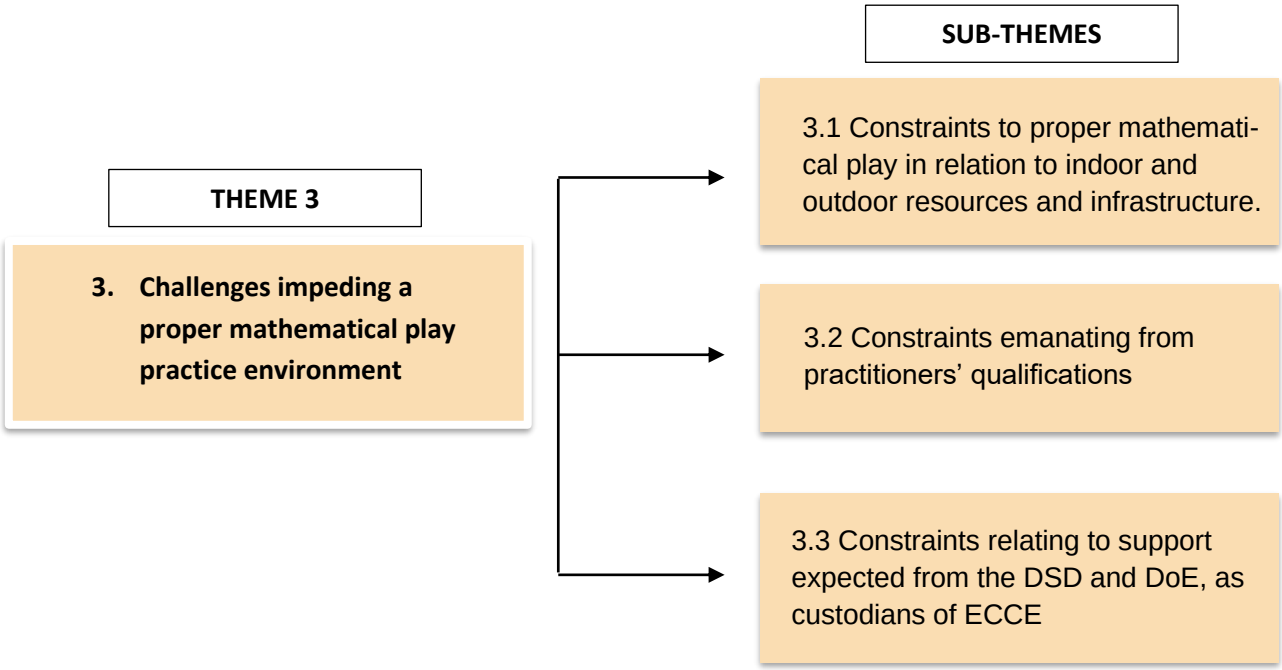
5. What measures would be ensuring that proper mathematical play practices are used for learning in this environment?

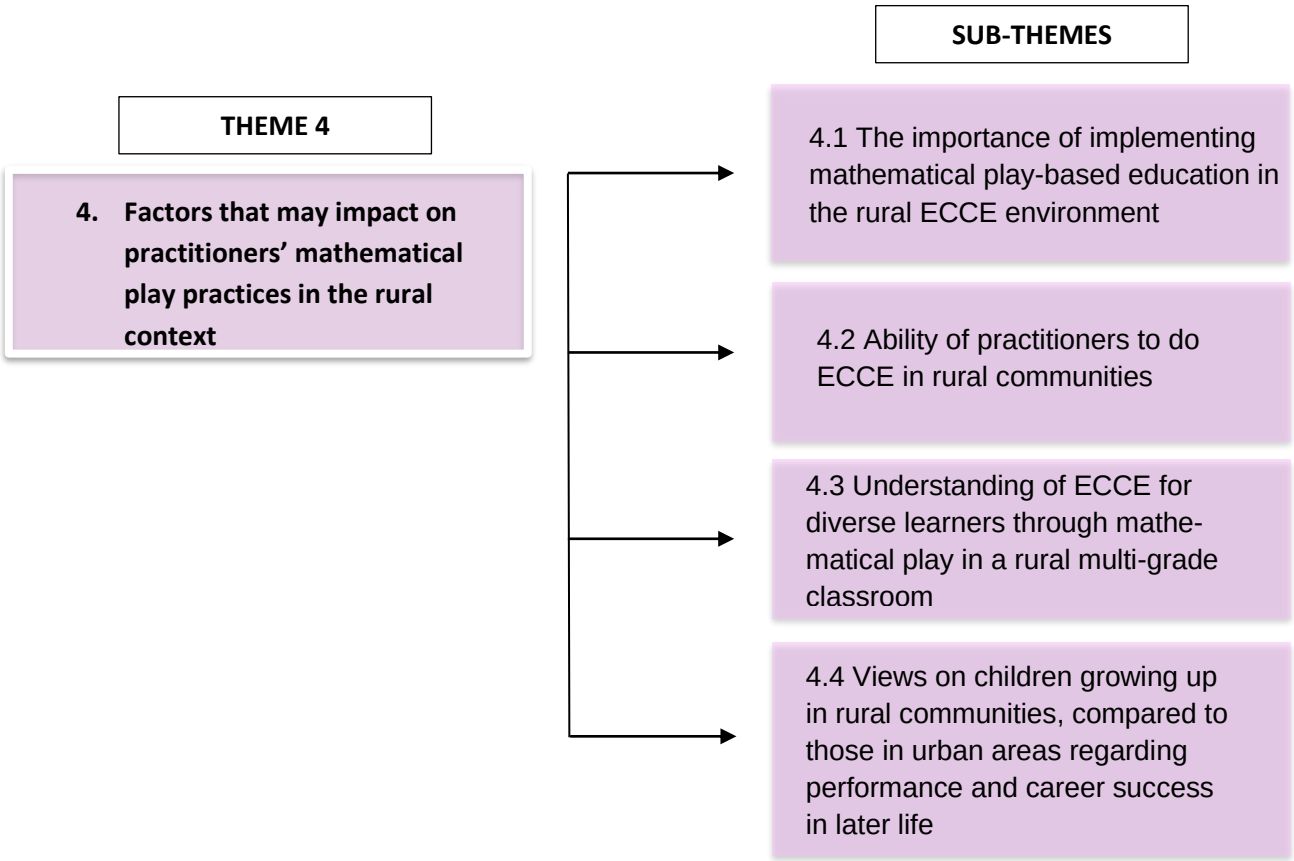
4.5 SAMPLING OF PARTICIPANTS

I conducted the study in Motheo District, in the Mangaung Municipality in the Free State Province. I used purposeful sampling (see Section 3.6). The sample comprised female participants who had experience of teaching young children in the ECCE setting and obtained matric certificate qualification with the exception of 1 participant. Five practitioners had experience in teaching children aged three, and another five were selected because they had experience of teaching children aged four. I had a specific purpose in mind, which was to generate a credible data that would respond to the main research question as well as the objective of the study. As I indicated in the preceding paragraph, this chapter is outlined according to themes, for which sub-themes had been identified. This process assisted in categorising and organising data according to common characteristics and labelled them according to different folders (*cf.* Section 3.10).

4.6 DATA ANALYSIS: THEMES AND SUB-THEMES




SUB-THEMES
THEME 3
3. Challenges impeding a proper mathematical play practice environment
3.1 Constraints to proper mathematical play in relation to indoor and outdoor resources and infrastructure.
3.2 Constraints emanating from practitioners' qualifications
3.3 Constraints relating to support expected from the DSD and DoE, as custodians of ECCE


SUB-THEMES
THEME 4
4. Factors that may impact on practitioners' mathematical play practices in the rural context
4.1 The importance of implementing mathematical play-based education in the rural ECCE environment
4.2 Ability of practitioners to do ECCE in rural communities
4.3 Understanding of ECCE for diverse learners through mathematical play in a rural multi-grade classroom
4.4 Views on children growing up in rural communities, compared to those in urban areas regarding performance and career success in later life

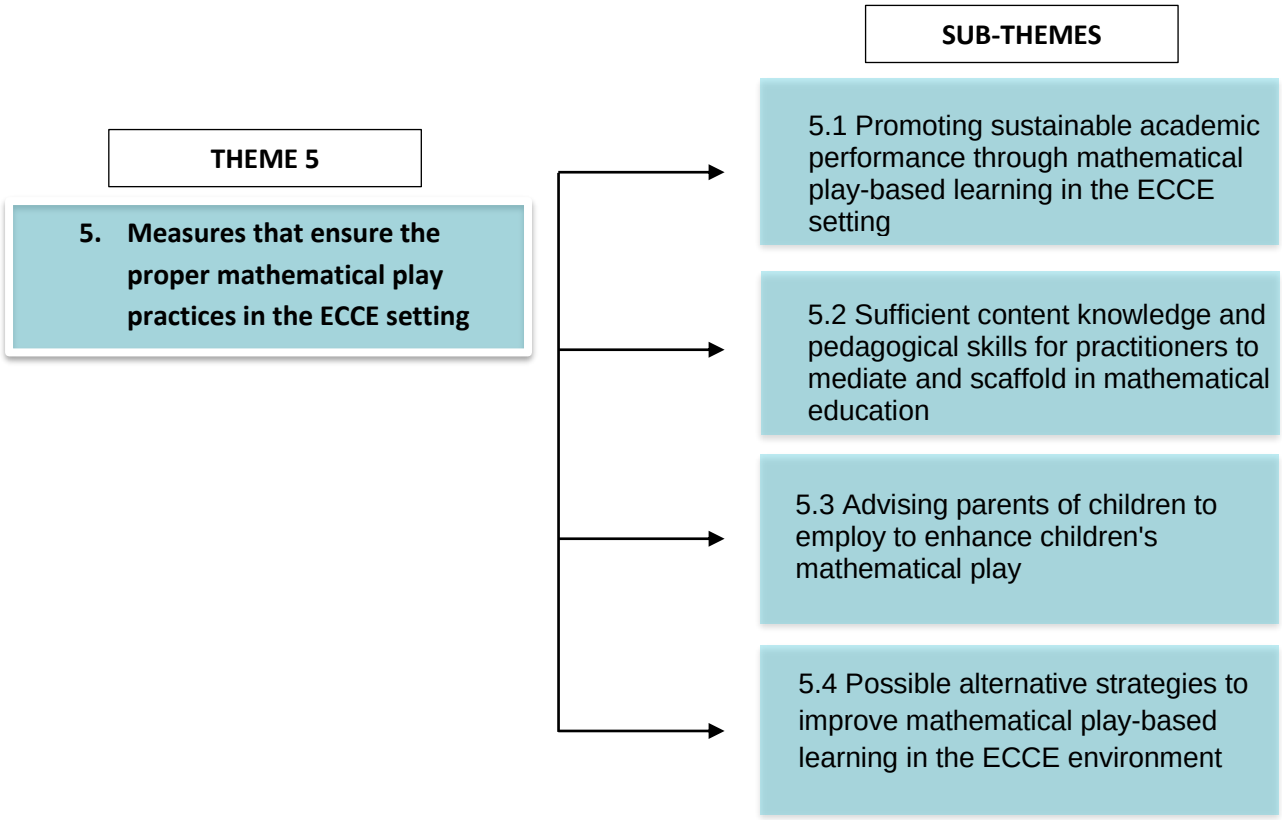


Figure 4.1: Data analysis: themes and sub-themes

In the following sections, the discourses representing the different themes and sub-themes will be discussed and supplemented by direct quotes of participants' responses. These responses emerged during the semi-structured interviews, which were used to collect data to respond to the main research question and the objectives of the study.

4.6.1 THEME 1: Practitioners' lived mathematical play practices in the ECCE setting

In the ECCE setting, play is regarded as an important source of development that affects children's mathematical learning positively. Furthermore, play is a key element of child development, which develops the necessary skills, including problem-solving with a peer group, and enhancing language skills in the early years. In support of this statement, I will discuss sub-themes 1.1, 1.2, 1.3, 1.4 and 1.5, which emerged from Theme 1.

4.6.1.1 Sub-Theme 1.1: Kinds of practices expected from practitioners in the ECCE setting

In the ECCE setting, there are certain practices that are expected of practitioners who work with children. Participants made the following utterances during semi-structured interviews:

> ***P2:*** *A teacher working in the ECCE is expected to have strong communication skill as young children do not always express themselves or communicate what they feel or want. Again, you should build relationships and exercise respect as children are very perceptive they act or respond according to how they are being treated.*
>
> ***P3:*** *The practices that are expected from me as a practitioner, I'm expected be passionate about children, to love and play with them, to enjoy everything that I would do with them because working with children here, I worked with adults, we have to give them love.*
>
> ***P4:*** *I would say the kind of practices from what I would say is more experience in a practitioner. Having to teach a child maths you must have experience and you must have the love for a child.*
>
> ***P5:*** *As a practitioner in the ECCE, you must take care of the children, because most of the children who come to crèche, are expecting love from us as their practitioner because sometimes they do not always get love at home or from their parents.*

Participants P2, P3, P4, P5 explained the practices that are expected of a teacher working in the ECCE setting. The most common practice mentioned by practitioners is to give love, to care, to be passionate, have a strong relationship with children and, most importantly, to have experience of teaching children in the ECCE setting. These comments link to the recommendation of Bukalo and Ijeama (2020:19), namely that it is not only toys that promote mathematical education in the ECCE setting. Through water and sand play, children practise eye–hand coordination, they develop skills for sharing, cooperation, respect, socialisation, team spirit, love, appreciation and acceptance.

4.6.1.2 Sub-Theme 1.2: Mathematical play practices that involve full participation by all children

In an interview session, participants were asked about their mathematical play practices that encouraged full participation by all children. This means are there are

some practices that are expected of practitioners, to ensure that children participate fully in mathematical play-based learning activities. The participants commented as follows:

> ***P1****: Through play, children learn to know each other and the work they are doing. This will then give children an opportunity to understand the mathematical language, which is first, second, third and fourth. They can also count how many are red, white, black, how many are circles, square, etc.*
>
> ***P4:*** *I would say the kind of practices from what I would say is more experience in a practitioner in maths. Basically, you must have love for children, you must be a parent to them in the centre.*
>
> ***P6:*** *I expect that when we are teaching anything, we will start with concrete object before we go to abstract in teaching. We always start concrete and with their own bodies, and they have to experience the things for themselves to be able to know something.*

The data reveals that practitioners employed different mathematical play practices to ensure the full participation of all children in mathematics education. P1 indicated that children should socialise with others. This response relates to the study conducted by Pascoe and Brennan (2017:76), who state that play is important for children's exploration, relationships, and interaction with others, including parents and teachers – play promotes quality ECE. P4 said that practitioners should have experience to teach mathematical play in the ECCE setting, and that practitioners' role involves an element of parenting, while P6 stated that children's mathematical play should move from a concrete to an abstract approach – an approach supported by Setlalentoa (2014:227). My finding is that all practitioner responses reported mathematical play practices in the ECCE, and that children will benefit from these practices if the practices are properly done.

4.6.1.3 Sub-Theme 1.3: Inspirational mathematics play-based learning to help children construct new knowledge

Mathematical play is quite noisy, messy, fun and interesting for young children and, at the same time, it inspires growth and intellectual development of language, literacy, logic and mathematics in the ECCE setting (Trundle & Smith, 2017:81). The following utterances by the practitioners responded to sub-theme 1.3:

P1: *Because children always have the eager to play and learn best through play. Introduce children to concepts and the thinking strategies that support the learning in their everyday lives. By making it enjoyable for the children, and fun.*

P5: *We use themes, for example, let's take the theme, 'about my family'. On that we can count the members in the family. We practice integration approach by doing that every time we teach.*

P7: *Play is an essential part of young children's lives. I usually use puzzles and ask children to put them together. The child must build, Unifix blocks and cubes (called manipulative). I teach number quantities by laying out number cards.*

Responses by different participants reveal different views on inspirational mathematical play-based learning for children that is intended to construct new knowledge. For instance, P1 believed children should be supported by making play fun and enjoyable. Themes should be integrated, suggested P5, while P7 recommended involving children in building puzzles and Unifix blocks. Practitioners claimed that these practices influence and inspire children's interest in participating in play-based mathematics by making it enjoyable and fun for the children. They also mention that building puzzles and blocks helps children to learn to count and solve problems.

4.6.1.4 Sub-Theme 1.4: Advocacy for stimulating, scaffolded and mediating play-based mathematics

Practitioners play a major role in advocating for appropriate practices that stimulate the learning of mathematics concepts. These practices involve purposeful play and child-directed play that is scaffolded and mediated to follow children's intuition in the ECCE setting (Feza, 2016:484).

The above statement was confirmed by participants' responses:

P7: *My work is to create and ensure the experience and activities of mathematical play and build on children's existing knowledge and understandings. Also encourage children to talk, think, reason and create a sense of curiosity in a playful way.*

P9*: Okay, so let us say, for example, we are learning about the numbers, one to five. Then the children will rotate through all the different play areas, as well. Then, the children that I can see that are struggling, I will call them aside and work with them for a while, and then set them out to go and play on their own.*

In light of statements by P7 and P9, it is evident that both these practitioners work to help children create new knowledge through communication, reasoning skills and guidance for those who are struggling to keep up with their peers through scaffolding and changing the roles (Rubtsov, 2017:29). This implies that a more capable peer could also take a lead in scaffolding the learning of other peers.

4.6.1.5 Sub-Theme 1.5: The importance of planning developmentally appropriate play-based learning

Participants were asked why it is important to plan play-based leaning as part of developmentally appropriate practice. They referred to different ways of planning to address different ages in the ECCE setting. They reported the following ways of and reasons for planning to engage children in mathematical play-based learning:

> ***P1:*** *Yes, we plan according to their developmental ages. Then we will look at the planning, which ones are good for that level of development.*
>
> ***P7:*** *I will say yes mam. My reasons are if you do not plan, as a practitioner, you will not notice what the needs of your children are. You will not be able to also improve your work or the way you are teaching. These developmentally appropriate practice are communication skills, develop key language and communication development of motor skills, holistic develop that include social and emotional development.*
>
> ***P9:*** *I plan and then I would go through my planning and consider each and every child in the class and how it will affect them and what I can do to explain it better to that certain child. Because you know your children and you know how they learn.*

The statements by P1, P7 and P9 indicate how each practitioner plans for developmentally appropriate activities. All three of them pointed out that, through planning, they are able see which activities are relevant for a certain age group. Doing so helps them to adjust their teaching strategies and get to know the children they teach better.

4.6.2 THEME 2: ECCE practitioners' preparedness for the mathematical play environment in CBCs

Practitioners in the ECCE setting are supposed to be well prepared when they engage children in mathematical play practice, to ensure their lessons cover the diverse needs of children in the class. A classroom should provide different teaching areas, so that

children can learn in different areas with other children and construct their own knowledge during mathematical play learning. Subthemes 2.1 to 2.5 emerged from Theme 2, and will be discussed below.

4.6.2.1 Sub-Theme 2.1: ECCE practitioners' preparations for mathematical play-based learning in different teaching areas

In the ECCE setting, it is important that practitioners engage children with meaningful and stimulating activities all the time; these activities should be set up in different teaching areas. It is also important that, during the activities, the practitioners are hands on in monitoring children in the different teaching areas. Below are some of the responses by participants about preparing for mathematical play-based teaching and learning in different areas.

> ***P1****: Because we have limited space in our classroom we have no teaching areas we use carpet area for teaching.*
>
> ***P5:*** *I ensure that all the necessary resources are ready for the children and all the teaching area are set in such a way that mathematical play-based learning will take place. I have teaching corner where reading and mathematics take place, art and music area, fantasy, block area and theme table.*
>
> ***P9****: Okay, so we have these nice shelves. So, each shelf has something different. So, for example, my first shelf is mathematical, like counting and puzzles and all those things. My second shelf is reading, story books and what-not. My third shelf is play toys, all over, and then the other one has blocks. So, then that is how my class is set out.*

Participants who were interviewed were aware that there should be different teaching areas in their classroom for mathematical play-based learning. By analysing their statements, it became clear that each participant had a way of ensuring that children were engaged in different mathematical play-based learning activities in the ECCE setting. For instance, P1 faced a challenge relating to space, but used a carpet as a teaching corner, where all teaching and learning of play-based mathematics took place. P5 indicated that their classroom had spaces where reading and mathematics were undertaken, an art and music area, and a fantasy and a block area and a theme table. These teaching corners are placed in such way that each child could learn mathematical concepts effectively, as the classroom is fully resourced. P9 stated that,

instead of creating different corners, all the resources were packed in shelves. The first shelf was for mathematics, the second shelf was for books, and the third shelf was for toys. It is evident that, even though practitioners had to improvise, they ensured that children were exposed to different teaching areas to know and understand mathematical education through play. However, practitioners face challenges related to a lack of resources and infrastructure, which impede their engagement of children in mathematical play-based leaning.

4.6.2.2 Sub-Theme 2.2: Teaching methods used to supplement mathematical play-based learning

The ECCE setting needs practitioners who understand how this environment operates. This statement is aligned with Beltramo (2017:327), who states that teachers must be provided with learning opportunities that resonate with children's contexts and their individual interests, social needs and learning preferences. These opportunities are lacking due to inadequate professional development of practitioners in the ECCE setting. During the semi-structured interviews, practitioners were asked about the methods they used to supplement mathematical play-based learning, and they responded as follows.

> ***P1:*** *The teaching method that I use is a visual method, so that they must see. Because there are children, those who learn visually, others will learn by hearing. if I put that poster there, every time when he looks at the poster on the wall, he will remember that, okay, teacher said this boy was doing this.*

> ***P6:*** *My teaching method not always be the same through different activities. If you work with shapes it will not always be that I am showing you the shapes on a card, I will give you things that you can feel it. I always start with things that they can associate with in class. Like for instance, when we start with circle, we will say the head. I always use different techniques to teach them they also need to predict what is coming, to keep learning interesting.*

> ***P9:*** *Okay, I enjoy one-on-one playing with children, especially if they struggle with something. For example, there was a boy in my class who struggled with counting, I would go and sit with him and just – without telling him we are going to play counting – I play, just play with him. So, that is, yes.*

From the above statements by practitioners, it is clear that each of them used a different teaching method to supplement the mathematical play environment in the ECCE setting. For instance, P1 and P6 preferred to teach through the visual, auditory and kinaesthetic methods, where children can see objects, touch it with their hands, and listen to the teacher telling them how to use that object. On the other hand, P9 teaches children individually, especially those who experience difficulty understanding mathematical play-based learning. Practitioners' utterances relate to the study by Pyle et al. (2018:222), which reveals that children's play occupies an important role in the ECCE setting. Therefore, the role of the teacher is vital for nurturing children's early personal and social development through learner-centred activities that will assist them to construct new ideas.

4.6.2.3 Sub-Theme 2.3: Preparing training and workshops, provisioning documents, support and monitoring to supplement play-based learning

To ensure that practitioners are able to engage children in play-based learning, teacher development programmes, relevant documents and support and monitoring should be provided to maximise practitioners' knowledge on developing children's numeracy skills in the ECCE setting. Chuta (2018:57) declares that teacher development is a focal point of teaching and learning. Development should deepen teachers' knowledge of subjects, sharpen their skills, and update their personal development. The practitioners in this study stated the following in response to sub-theme 2.3.

> ***P1:*** *Here in the centre, we have the books that we use for language and mathematics and life skills. It is three-in-one, because it has subjects. We choose the leaders, those who will help us with other things that we do not know.*
>
> ***P2:*** *No, most of the time I Google what I am supposed to teach and sometimes I have to think out of box in order to teach.*
>
> ***P5:*** *Yes, an NGO trained us on how teaching small children. This was for a short time; it was something that we learnt there but they never come back again.*
>
> ***P6:*** *No, I am going to say no on that. The things we are doing, we just think for ourselves. We did not get specific training or work that will give us hundred percent ideas of what to do, but we share ideas as a team at our school.*

P10: *We get workshop, but not a lot. It used to happen, but now recently, no. I want to be honest, no, no more follow-ups.*

I deduced from practitioners' statements that they depended on their colleagues and NGOs for advice, training and workshops; the latter two take place rarely (P1, P5, P6 and P10). Participants use available means to supplement their play-based mathematics teaching, such as internet searches, creative thinking and, sometimes, sharing ideas among themselves (P2, P5 and P6).

4.6.2.4 Sub-Theme 2.4: Practitioners' perceptions of and beliefs about employing an integrated lesson plan in mathematical play

Practitioners' perceptions and beliefs affect their use of integrated mathematical play-based learning in the ECCE setting. During the interview sessions, practitioners commented as follows in response to sub-theme 2.4.

P5: *I think children will learn easily through play because most of what we do is playing with them. That is how they can learn fast.*

P7: *I believe that my lesson must be integrated because it will assist to develop the child holistically*

P10: *Yes, I believe in making teaching easier because we can even do it without making it hard, especially for the kids. Like you were making an example now of my body. It can be a theme by itself, and from there, we can learn body parts, language. We can learn the functions, life skills without even knowing they learn.*

In general, expressions during this interview session indicated that practitioners have different perceptions and beliefs regarding the use of integrated lesson plans for mathematical play. In response to this sub-theme, P5 said that children learn easily and quickly through play. P7 had the perception that integrating lessons through mathematical play-based learning, communication and life skills contributed to holistic development of children. P10 said that learning must be made easier for children, and that planning should integrate all the subjects in the ECCE setting, so that children can learn and understand mathematical play-based learning.

4.6.2.5 Sub-Theme 2.5: Considering cultural background and social context during daily programme in the ECCE setting

Most of CBCs enrolled children from a variety of cultures, which sometimes made it difficult for practitioners to reach all the children in the diverse classroom. Due to the diverse nature of the classroom, practitioners must consider the social context of the children in daily programmes of mathematical play-based leaning. Excell and Linington (2015:28) assert that children are actively involved in their learning and in constructing new knowledge, hence, their social context is important. Below are some of the practitioners' comments regarding cultural background and social context during the daily mathematical play programme in the ECCE setting.

> ***P2:*** *When we are playing, firstly, we are not biased, so we do not look at the culture of the children, we just include everyone so that everyone will be comfortable when we do activities.*

> ***P8:*** *I need to know that the activities are not cultural or being racist based. They are for everyone. The other one if they like to play with this thing, I put them aside and the other one at that side, so that they can communicate, they can share.*

As social context is one of the factors that can affect child development during daily programmes, P2 and P8 indicated that, when they play with children, practitioners should not be biased but must include all children in all the activities, and should avoid bias and racism. In this way, children will feel comfortable, and they will be able to communicate and share with others. It is important to consider children's cultural and social backgrounds, as it provides them with a sense of identity and belonging.

4.6.3 THEME 3: Challenges impeding a proper mathematical play practice environment

The diverse nature of the ECCE environment poses challenges that hinder practitioners from engaging children in proper mathematical play practice in the ECCE environment. These challenges will be discussed under sub-themes 3.1 to 3.3.

4.6.3.1 Sub-Theme 3.1: Constraints to proper mathematical play in relation to indoor and outdoor resources and infrastructure

In the Motheo district, practitioners and children face an array of challenges, among others, poor support from government, a lack of quality education on the side of

practitioners, poverty, poor health services provided by government in the ECCE and lack of sanitary facilities. All these factors have an impact on teaching and mathematical play-based learning in the ECCE setting. These constraints are confirmed by Mabaso (2017:47), who reports a lack of educational tools and facilities, foo few adequately qualified teachers and high teacher–learner ratios, and a shortage of early childhood services, resulting in most learners being academically disadvantaged. Furthermore, participants confirmed these statements with the following affirmations.

> ***P1****: Challenges we are facing is that we have is that, sometimes in our classes we do not have enough space, so that all the children can participate. Even if you use your own language, their own language, they cannot understand. They need to see something concrete for to be able to learn.*
>
> ***P4:*** *I would find it very challenging for me because in my class I have a child with a disability in a way that I must also focus on the child. Children then fall behind and another challenge is that we lack resource and space to teach mathematical play.*
>
> ***P6:*** *At this school, it is a little bit difficult, because we do not employ male to help us to maintain the outdoor equipment. You cannot just get it and then you do not look after it, so in my planning for every year and when we are doing budget. I buy salt instead of chlorine for the sandpit maintenance then once a month.*
>
> ***P7:*** *Challenges faced by learners with a learning disability that affects performance in mathematics. No referrals for these children with such problems. I am not qualified and this makes difficult for to teach such learners Overcrowded classrooms, infrastructure of the centre, resources such as learning materials and funding are lacking.*

From the comments of participants above, I conclude that practitioners collectively face multiple challenges that prevent them from engaging children in proper mathematical play practices in the ECCE environment. These constraints include those posed by the indoor and outdoor area and range from a lack of space, poor infrastructure, lack of resources and overcrowding of ECCE classrooms (P1, P4 and P7). In turn, P1 reported that language posed a barrier that makes it impossible for some children to understand mathematical play-based learning in the ECCE setting. Some practitioners reported being stretched beyond their expertise, as they were facing the challenge of teaching children with disabilities, without access to guidance on how to refer these children to a relevant specialist or school (P4 and P7). One of

the participants stated that there were no men appointed by the ECCE centres to assist with maintenance of indoor and outdoor equipment (P6). Most practitioners experienced similar constraints, which made it difficult for them to engage children in mathematical play-based learning in the ECCE setting.

4.6.3.2 Sub-Theme 3.2: Constraints emanating from practitioners' qualifications

Qualified, skilled practitioners are required to implement mathematical play-based learning in the ECCE setting. According to Jawawi (2019:222), teachers' experience and qualifications influence their perceptions of differentiated teaching. Some teachers lack the expertise and knowledge to implement a differentiated teaching strategy in the early years, with specific reference to mathematical play-based learning. During my conversations with participants on challenges that impede them from implementing mathematical play effectively, as per sub-theme 3.2, they reported as follows:

> ***P1****: Now, I have, B Ed. in Foundation Phase. I just finished now but I did not get job that is paying me enough, I am working in this centre while I am looking for the job that matches my qualification.*
>
> ***P5:*** *Yes. We do not have the same qualification like other practitioners. I have only Grade 11. In most of the time, I have to ask other practitioner what I must do for the lesson. If we can at least go to school; or have somebody who will train us to teach small children in the preschool or have a workshop; it will at least balance our education.*
>
> ***P7:*** *I am not sure whether there is any institution locally which can give us relevant requirement and qualification for ECCE practitioners except the TVET where we study, I studied ECD NQF Level 4. I am studying my ECD NQF Level 5 now, which has mathematics as its core module.*
>
> ***P10****: Yes, I studied Level 4 ECD. By the way, it was a long time ago and I hear now that they are saying, it is not really weighed and valued that much. Now there is many opportunities out there, but now I have only done ECD [Level 4], I cannot go to higher institutions.*

The comments above indicate that the majority of participants (P4, P7, P9, P10) are educated to Level 4 ECD. Only one participant reported that they had a B Ed for foundation phase. In the ECCE setting, practitioners' educational backgrounds and

their training as child workers are an important requirement that continues to be raised all over the world as one of the most accurate predictors a child's holistic development. Therefore, it is vital that practitioners obtain adequate qualifications, so that they can engage children in mathematical play learning in the ECCE setting.

Findings that emanated from the data reveal that the most common challenge facing practitioners is that they do not have adequate qualifications to teach in the ECCE setting. Consequently, they are unable to engage children in the proper mathematical play-based education, with the exception of P1, who is qualified, but looking for a position that matches her qualification better.

4.6.3.3 Sub-Theme 3.3: Constraints relating to support expected from the DSD and DBE, as custodians of ECCE

In the current situation, function shifts are taking place between the DBE and DSD. This migration leaves most of practitioners unsure about their future career in the ECCE setting. They are unsure which of the two departments is responsible for their professional development, will provide funding for their centres, and provide teaching and learning resources. Their concerns were expressed in one of the interview sessions, when they were asked about the support they expected from the DSD and DoE, as custodians of ECCE.

> ***P4:*** *I want to expect funding so that we can go to university of improve my qualification and also to buy resources for the kids and make better classes for the kids.*
>
> ***P7****: Training, on-site support for practitioners, programmes for play-base mathematics indoor and outdoor equipment that can be used for mathematical play e.g. trampolines, unfix blocks to be provided.*
>
> ***P9:*** *Okay, so I think that Social Development, there should be a clear understanding of how they were running things, so that the Department of Education can, it is not that big of a move for people. But I also expect from the Department of Education, that when they see there is a need or something that was missed, that they do implement it and bring it in.*

Participants had different views on the responsibilities of the DSD and DBE, for instance, P4 indicated that funding for practitioners to improve their qualifications and purchase resources is expected from two departments. P7 commented that receiving on-site training and programmes on play-based learning, with special reference to that

needed for mathematics indoor and outdoor play, will be useful to them. P10 indicated that the two departments should clarify their duties and implement arrangements accordingly. This shows that there is still uncertainty among practitioners on how the two departments will support them and their role in ECCE.

4.6.4 THEME 4: Factors that may impact practitioners' mathematical play practices in the rural context

Children's performance, particularly in mathematical play in rural areas, compared to urban areas, is not up to standard, and a number of factors that impact on practitioners' mathematical play practices in a rural context were discussed under sub-theme 4.1, which emerged from theme 4.

4.6.4.1 Sub-Theme 4.1: The importance of implementing mathematical play-based education in the rural ECCE environment

One of the factors that is troubling in the field of ECCE is the implementation of play-based learning in the rural ECCE environment. During the semi-structured interview sessions, participants were asked whether it is important to implement mathematical play-based education in rural ECCE environments (sub-theme 4.1). The following matters were raised by participants.

> ***P1:*** *Yes. It is very important as in the rural areas there are also young children who need play-based mathematics. I think, you know, because every child has a right to education. I do not think they must be left out because even in the rural areas, learning mathematics open many doors.*

> ***P6:*** *My answer is definitely yes. We are seeing it here at this pre-primary, because there are kids coming that have never been in a school or, I do not want to say school, in a pre-school, in a day care or a whatever, so they are so far behind. Would it not be wonderful if we can give all children the same education and the same chances to be on the same levels?*

> ***P9****: Yes, definitely it should be implemented. It does not mean because it is a rural area that it should not have the same education that other areas are receiving. I understand that there might be challenges but you can find ways to overcome them or be creative in maybe doing something else. But I do not think that you should not do it because it is just a rural area.*

Participants P1, P6 and P9 commented that the implementation of mathematical play-based education in rural ECCE environments is important. P1 said that all children have the same rights to education and no child should be excluded from mathematical play-based learning (RSA DJCD, 1996; UNICEF, 1989). P6 and P9 agreed that it is important that all rural children are provided with the same education, and the same chances to reach high levels of achievement and to be creative – just like children living in urban areas. The implication is that all children have the right to learn, despite the context they find themselves in.

4.6.4.2 Sub-Theme 4.2: Ability of practitioners to teach ECCE in rural communities

Rural communities are often ignored in relation to teaching and learning in the ECCE setting (Biersteker et al., 2016:337). Practitioners said they would not be able to teach in this environment. Considering the situation in rural areas, more teachers who are competent and have unique abilities are needed there, because children in rural areas deserve the same quality teaching as their counterparts in urban areas. Therefore, participants were asked whether they would be able to teach in rural communities, and they responded as follows.

> ***P2:*** *I would say that the children come from different background. Some of them would have so much interest in mathematics but some; others will not even bother to learn. If you would ask the child, "What did you do at home?" they would not even have an interest. I think it is because of the environment they are living in and this will be difficult to be able to work there.*
>
> ***P7****: Distance to the ECCE centres as well as mode of transport used is a challenge. Therefore, my mathematical play would be challenged by the resources and well as the absence of the children on a daily basis at the centres. Centres would also not be viable because of financial constraints this is something that I will not be able do or work there.*
>
> ***P10****: Is that all in one class now, and one me? I honestly, I do not think I would be able to do it. The furthest I can go is to put them in their age groups, and then from there, whatever it is that I can even prepare to teach, I do not think it will accommodate all of them, the way that it should. So, I really do not know how to handle that one.*

Participants' comments indicate that there is a need for children in the community to be provided with mathematics education. However, P1 indicated that the different background of the children plays a role in enabling practitioners to engage children in play-based mathematics due to the children's home environments, which lack stimulation for learning. P7 believed that remoteness and lack of transport hinder the ability of the practitioners to implement play-based learning. Generally, children find it difficult to cope, even if the practitioners are ready, the distance learners have to travel to school, as well as financial constraints, make it difficult to do teaching and learning, even when teachers are prepared to teach. P10 was of the view that it is difficult to teach a variety of children of different grades in one classroom, as teachers have no expertise on how to handle such classroom situations. This implies that, even though practitioners are able and prepared to teach in the rural ECCE setting, they found it difficult to implement teaching and learning due to challenges that relate to rurality.

4.6.4.3 Sub-Theme 4.3: Understanding of ECCE for diverse learners through mathematical play in a rural multi-grade classroom

Multi-grade teaching is common in rural areas. It is a teaching environment in which the teacher handles more than one grade in the same classroom, at the same time. In this type of environment, children of different ages and subjects are in one classroom and depend completely on the teacher(s) to guide and support them. Furthermore, Crouch et al. (2020:161) report that there is generally poor access to pre-primary programmes in rural areas, resulting in most children lacking a solid foundation in the ECCE setting. This is evident from the comment made by participants:

P1: *Okay, it is going to be difficult, because if you have different children with different ages and grade is not going to be manageable for me. I have to do the planning for each grade and age not good at all. It is going to be a little bit difficult. It is better when there is only one grade that you are responsible to teach.*

P6: *I think if you put me there, I am going to be exactly in the way that I am here at our ECCE centre. I just want to explain what I mean. Does not matter if I look different from them. I will really make something out of the nothing; to make it interesting for children to learn or to let them also experience through their bodies and homemade concrete mathematics resources.*

P7: *This makes it difficult because the four-year-old babies might be together with the seven years old. There might even be one four-year child and more than one in the other grades.*

However, the resources used are the same and I would use them according to the levels of understanding of those children. This will automatically bring the children together – the older one teaching the younger one.

P10: *I will not be able because number one, the age differences and obviously, the kids, the children are not the same. They might not be well developed to handle what a Grade 3 learner can, because the others are younger compared to the older ones.*

The data reveals the views of practitioners on their ability to teach ECCE in rural communities. Some of the participants (P1, P7, P10) said that it would be difficult or impossible for them to teach in a multi-grade classroom in a rural environment, as they would have to deal with children in different grades and of different ages. They believed it is better if a practitioner deals with only one grade. One participant (P6) had a different opinion; she said it would not matter to her, as she would use the same teaching methods.

My understanding of these responses is that, in order for practitioners to be able to teach in rural communities, they would have to adapt their teaching strategies to address the diverse needs of the children in their classrooms. They should be able to involve all children in all the activities through developmentally appropriate planning that is suitable for their different ages, grades and subjects. Teachers would also have to organise material in such way that it addresses all the diverse needs of the children in a multi-grade classroom.

4.6.4.4 Sub-Theme 4.3: Views on children growing up in rural communities, compared to those in urban areas regarding performance and career success in later life

There are disparities between children who grow in urban and rural areas (Echazarra & Radinger, 2019:17). In their comments during the interview sessions, participants expressed different views when they were asked how children growing up in rural communities compare to those in urban areas regarding performance and career success later in life. They commented as follows:

> ***P1:*** *There are children in the rural areas that make an excellent progress with regard to career development. If you can look at our new generation now. The ones who are in the urban areas are exposed to developments, I think, they have everything. Those who are in the rural areas, some of them, they do not have resources and transport to*

take them to school, let alone, technology skills due to rurality. If they can be given a chance, they can learn successfully. We should plan our daily lessons to cater for them.

P2: *They have everything they do not struggle to learn in the school the, attend. On the other hand, there are people who have gone in the rural school setting and some of them are doctors, and the late President Mandela was from the rural areas and then he was a president until he passed on.*

P6*: Okay, that is also a very easy question for me to answer. A child, who gets the right support, does not matter where they grew up, will excel exactly the way that any other one will excel. If they get the correct support and if they get the same stimulation, they can also excel in the same way.*

P7*: Children in rural areas are not able to have resources especially those that need technology because of data and network problem. The poverty also plays a part in the rural areas. Distance to the ECCE centre as well as mode of transport used is a challenge. Therefore, my mathematical play would be challenged by the resources and well as the absence of the children on a daily basis at the centres. Centres would also not be viable because of financial constraints.*

Baxter et al. (2010:6) point out that access to services, and educational aspirations are generally more limited in rural areas than in urban areas. Despite these differences, practitioners responded that children growing up in rural communities could make excellent progress for career development. For example, P2 used the example of the late President Nelson Mandela, who grew up in a rural community but became a successful president. P6 mentioned that support and stimulation will help children to excel despite their environment. Lack of resources was mentioned by the participants in relation to rural areas, including lack of exposure to technological education, and the need to travel long distances from home to school. They feel that more support is given to children in urban than in rural areas, which could make it difficult for mathematical play-based learning to succeed in the ECCE setting.

4.6.5 THEME 5: Measures that ensure the proper mathematical play practices in the ECCE setting

Play is one of the most important strategies to introduce children to and provide them with the essential skills they need to learn mathematics. Therefore, is important to

have measures in place to ensure proper mathematical play practices in the ECCE setting. Sub-themes 5.1 to 5.4 emerged from theme 5 in relation to these measures.

4.6.5.1 Sub-Theme 5.1: Promoting sustainable academic performance through mathematical play-based learning in the ECCE setting

Taking part in teacher development programmes is one of the methods that is sustainable for promoting academic performance in the ECCE setting. Sustainability goes beyond just doing good; what is needed is to ensure that the good is maintained at that level. During the semi-structured interviews, the participants reported the following:

> ***P1:*** *I think … I will motivate children to work hard on all the activities. If we can make use of the resources that will help them to learn will strengthen the mathematical play-based learning.*
>
> ***P4:*** *Oh, I teach them. For example, in the morning ring I try to put a beat in or put a rhythm of clapping hands in the song, when they can sing with the right tempo I leave clapping hands and let them sing without hands clapping.*
>
> ***P8:*** *I will use things that are simple that they see every day. Once he or she is at home, once she sees something, she will remember that my teacher tells me about this and this is what.*

To ensure that sustainable academic performance is promoted through mathematical play-based learning in the ECCE setting, P1 indicated that motivation and utilisation of resources will help to sustain academic performance in the ECCE setting. P4 believed that including songs and rhythm to scaffold children during morning ring will help them to perform well in mathematical play, and maintain that performance. Referring to items that children see every day will trigger their memories, which should promote sustainable academic performance through mathematical play-based learning in the ECCE setting. Participants had various opinions about promoting sustainable academic performance through mathematical play-based learning in the ECCE setting.

4.6.5.2 Sub-Theme 5.2: Sufficient content knowledge and pedagogical skills for practitioners to mediate and scaffold in mathematical education

Sufficient content and pedagogical knowledge are needed by teachers before they even enter the class; teachers need to master the content of the subject they will be teaching. This knowledge will assist teachers to revise the work they had covered previously, even before they engage children with new content, particularly mathematics concepts. Vijayan (2018:52) reveals that children learn in numerous ways and a practitioner is expected to understand this, as well as possess the pedagogical skills needed to use these experiences in day-to-day interactions in the ECCE setting. The data reveals the following responses from practitioners:

> ***P2:*** *I will prepare my lessons in a way that each learner is included in the lesson, and as I know my learners, it will be a bit easier for me to manage my classroom. Again, I will create a very conducive learning environment that will benefit each one of my learners.*

> ***P3:*** *I have to be very creative ma'am because at some point I used to tell them that they should bring the tray so that we paint them and using different colours. Whenever they see a certain colour they will tell me this is red, this is blue, this is green and so forth. I use everything that I can to engage them that it is interesting.*

These quotes indicate that P2 and P3 employed learner-centred approaches to teaching and learning. They merely facilitated teaching and learning through mathematical play, and the children take control of the lesson. The responses are supported by the National Integrated Early Childhood Development Policy, which encourages practitioners to afford children opportunities to learn through play, in order to promote and acquire mathematics skills, and to reduce inequality and improve educational opportunities and access for all children (DSD, 2015:7). It is, therefore important that practitioners in the ECCE setting understand what pedagogical and content knowledge entails.

4.6.5.3 Sub-Theme 5.3: Advising parents of children to employ and to enhance children's mathematical play

It is important that parents support their children's learning. Therefore, strong relationships between parents and their children will enhance positive outcomes from mathematical play-based learning. If parents are to play a role in teaching and

learning, they need to receive support and information from the school, so that they can assist their children at home. When the participants were asked how they advised parents of children to employ play to help their children learn, this is what participants had to say:

> ***P2:*** *I will ask the parents to buy learners mathematical games that will enhance the learners' learning. I will ask the parents to go with their children to shopping centres and engage with the learner in counting. Lastly, I will ask parents to do the daily homework with the learners.*
>
> ***P3:*** *We give them homework sometimes. I would encourage the parents to anything that you see ask the child "what kind of a shape is this?" A house maybe, tyres, the shape of the house it is a triangle, things like that.*
>
> ***P4:*** *Cutting fruit of vegetables into half or quarter (apple or potatoes). Mentioning colour of the food like orange pumpkin and red beetroot. Mentioning round table and square table. How many members of the family, counting plates and cutlery.*
>
> ***P7****: Children should tell and show them any number they see at home. Whenever they walk in the house children should tell them how many walks they have done. Whatever they do at home the children should do the counting of that.*
>
> ***P9:*** *I think that if parents have questions, they should ask the teachers how I can help them. I would suggest that parents also buy more educational toys at home and not just having normal toys. Although they are important, definitely, but I think to also have it at home, will help the children to develop faster.*

Comments by the majority of participants revealed that, in order to enhance children's mathematical play, practitioners give children homework. They also encourage parents to engage children in cutting up fruit and vegetables (fractions and shapes), naming foods, and counting cutlery and family members at home.

The participants' responses confirm what Goshin et al. (2021:907) found in a study on strategies to encourage parental involvement in adolescents' education and extracurricular activities. They found that it is important that teachers train parents to create a supportive home environment that is conducive and stimulating and which assists children to solve emerging problems in teaching and learning, and to help them with homework and to cope with their daily school encounters. The implication is that,

for children to be successful and to understand mathematical play-based learning, cooperation between parents and practitioners is important.

4.6.5.4 Sub-Theme 5.4: Possible alternative strategies to improve mathematical play-based learning in the ECCE environment

Most practitioners tend to follow same style of teaching, to follow one pattern and trust the same method when teaching in the ECC setting. In order to improve mathematical play-based learning in the ECCE setting, possible alternative strategies were identified by participants during the semi-structured interviews, as indicated below:

> ***P6:*** *Any suggestion? [Silence] If I really can suggest something, is that it would be very nice, if you can get maybe, if the groups could have been smaller so that you can accomplish your goals. It is very difficult to work with big groups, but we need teacher assistance. It must be someone who can have the qualification. I am one of the lucky ones; I am saying lucky ones that got my education at a college. They must bring it back. I have nothing against degrees at university, nothing ma'am, but I can see the difference between students that is coming now, and students of twenty [years] back. The education we got was so much deeper, because they gave us the practical experiences, they teach us the things that I know today and that is what I wish we could bring back to our little ones. Not just anyone opening a crèche and just let children sleep the whole day.*
>
> ***P7:*** *I think parents can also come to school tell children stories to improve their communication and assist with being part of committee that runs the centre and contribute towards holistic development of the children.*
>
> ***P10:*** *Okay, they can use, they can collect things like ice cream sticks. They can use that for maybe counting. And also bottle caps, wash it, keep it there, somewhere, especially if they have colour, then at least they will not be bored, having to use things like that. And, let me see what else can be used. Should it be things that they do not have to buy?*

Practitioners suggested different alternatives and additional strategies that they believed could improve mathematical play practices in the ECCE environment. These are their suggestions: P6 suggested that children should be allocated to small groups; when the groups are bigger, teachers' assistants should be provided. Bringing back teacher education colleges was one of the suggestions; the view was that the training provided by colleges was more practical. P7 suggested that parents should be invited

to school to tell the children stories. P10 suggested collecting recycled material, like ice cream sticks that can be used for counting, and bottle tops of different colours that can be used for sorting and learning about colours. From the information above, it is clear that that various alternatives can be used in an effort to improve mathematical play.

4.7 OBSERVATIONS

The study used observation as an instrument to generate data, thus, to support the data generated by the semi-structured interviews and my journal entries during the fieldwork. These observation sessions were conducted in five CBCs in in Mangaung, which were coded A to E, as indicated in Table 4.1, to maintain anonymity. The observations were aligned with the themes and sub-themes in the preceding section (Table 4.1), to assist me to address the main research question: What are practitioners' lived mathematical play practices in early childhood care and education settings?

First, I observed how practitioners interacted with children during play-based mathematics involving scaffolding and mediation for children in different teaching areas, and using different teaching and learning resources to enhance mathematics in the ECCE setting. In the session, I also ensured that that I observed practitioners' preparedness for mathematical play in the CBCs, and linked what I observed with aspects of the theory underpinning the study (see Section 2.2) and how those aspects influence teachers' daily practice in mathematical play-based education.

Secondly, I observed the challenges encountered by practitioners while they engaged children in mathematical play-based education during indoor and indoor activities, which included the rural context as a constraint for quality ECCE provisioning. During observations, I used photos to demonstrate how ECCE practitioners engage children in mathematical play-based learning.

5.1.1 Practitioners' mathematical play practices through scaffolding and mediation in the ECCE setting

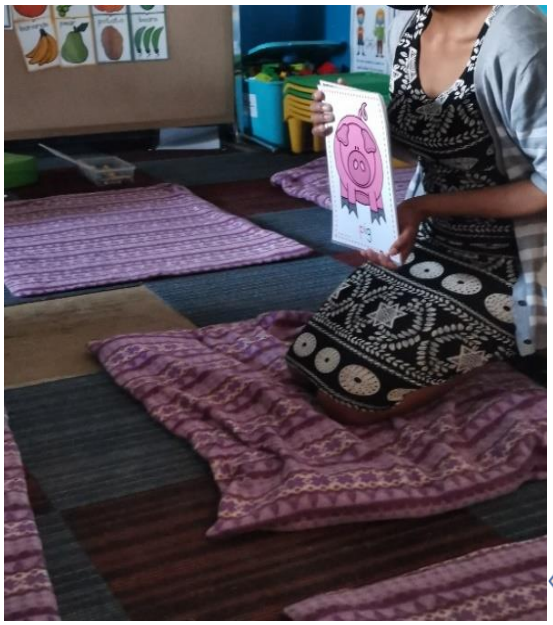


Photo 4.1: Teacher prepares for storytelling

Photo 4.2: Children seated on carpet

The practitioner in Photograph 4.1 is interacting with children during mathematical play-based learning through storytelling, to teach mathematics concepts. The practitioner told the children that it was story-time and to take up positions on the carpet to prepare themselves for the story. In this way they understood that mathematical play learning was part of that day's lesson. This was done through teacher-guided activity. All the children sat on the carpet and prepared to listen to their practitioner's instructions, as indicated in Photo 4.2.

Hedges (2014:200) insists that practitioners should come to the fore and locate themselves within the play-based teaching and learning approach. I observed the practitioner in this classroom engaging and interacting with children through verbal communication. She knelt down so that she could be on the same level as the children. During storytelling, the practitioner created dialogue between herself and the children, and gave them the opportunity to create new knowledge through socialisation with others (Section 2.2.1.1).

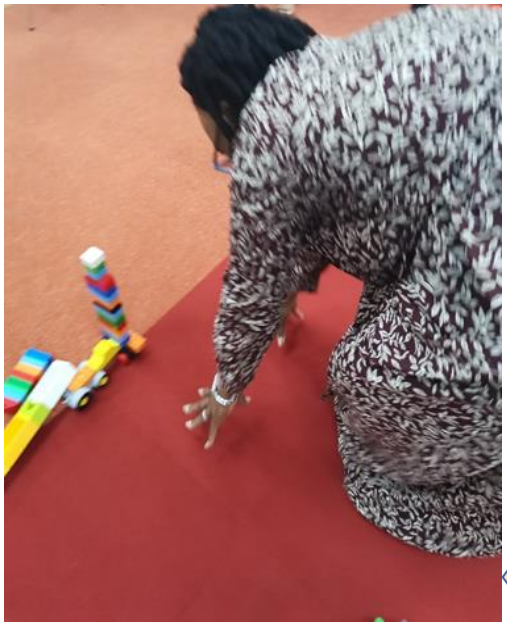


Photo 4.3: Hands-on involvement of teacher

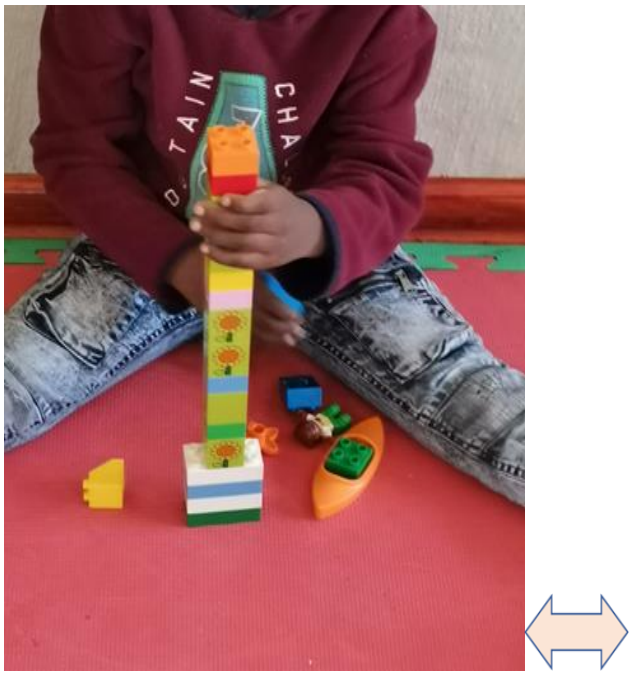


Photo 4.4: Hands-on involvement of child

Photos 4.3 shows the practitioner I observed focusing on teaching the children counting, to handle data, and about different colours and sizes using Lego bricks. In Photo 4.4, the child is hands on while the teacher directs the activity. First, the practitioner prepared herself to sit on a carpet with the children – I consider the area to be the ZPD (*cf.* 2.2.1).

During this process, practitioner 2, as the knower, was scaffolding children in the ECCE play-based mathematical education classroom on how to use Lego bricks for different reasons (Section 2.4.1.4). The practitioner guided children in using Lego bricks, which they could touch and manipulate, use to recognise numbers, learn ordering and involve their kinaesthetic skills while learning through play with guidance. This implies that, once the child is able to execute the task alone, support can by withdrawn by the more knowledgeable other, in this context, the more knowledgeable other is the practitioner (Vygotsky, 1978).

As stated in the literature (Section 2.2.1.3), a child who cannot solve a play-based mathematics problem might be able to do so with the help and guidance of more knowledgeable others (Michael, 2013:26).

Photo 4.5: Teaching geometric shapes

Photo 4.6: Painting a triangle orange

I had an opportunity to observe another instance of ECCE play-based learning in one of the centres. As indicated in Photo 4.5, the practitioner was teaching children geometric shapes. She stands in front of the classroom with a real, concrete object – a house. This is a relevant strategy in teaching and learning in the early years. After teaching, she requested the children to draw a triangle shape and to paint it orange.

During teaching and learning, I observed that she was still standing in front of the classroom; she did not move around to guide the children on how to carry out that task. She had detached herself from interacting with the children, by standing in front of the children, and not at at the same level as they were. The implication is that she was unable to conceptualise ECCE in the context (Section 2.3.1).

Nilsen (2017:217) reports that ECCE is a critical period for cognitive, social, emotional, and physical development, during which the child requires an adequately stimulating environment for social interaction with other children (Section 2.3.1). My implication is that practitioners who work with children should possess certain a personality, which includes the traits of passion, kindness, love, caring and respect, as alluded by most participants during data collection (see subtheme 1.1, Section 4.6.1.1).

Classroom environment for mathematical play during teacher-guided activity

Photo 4.7: Counting with bottle tops

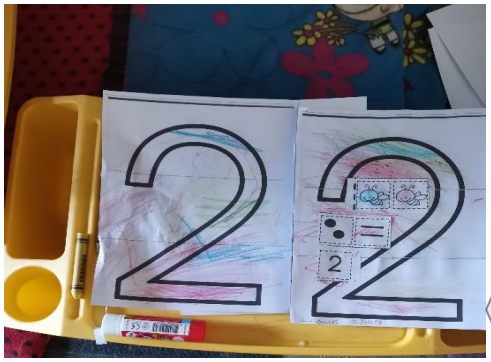


Photo 4.8:Tracing the number 2

Photo 4.9: Geometrical shape and colouring

During observation, I failed to see the teacher walking around to ensure that children are engaged in the activity of counting and naming the colour correctly. Mathematics requires the teacher to be hands on. A hands-on teacher is always next to the child and give guidance and support that is needed in the ECCE setting (Section 2.3.2; Ginsburg et al., 2008:3).

I also observed, in another class, where children were taught to trace the number 2 (two). Some children just coloured over the picture of the number 2, as shown in Photo 4.8. They did not use their crayons inside the lines, as the teacher had instructed. She did not monitor the children's work, and it appears that the practitioner did not understand the main purpose of teacher-guided activity (Section 2.3.2; Siyepu, 2013:10).

In another mathematics classroom, the practitioner identified the shape that the children should cut and colour. Because the teachers did not mediate this activity, some children coloured it incorrectly, others struggled to hold the scissors. While the children were busy with teacher-guided activity, the practitioner was doing administrative work. She did not offer mathematics education that exposed children to deep, explicit and high-level mathematics knowledge that prepared them for a formal teaching and learning environment (Section 2.3.2; Setoromo & Hadebe-Ndlovu, 2020:1).

Photo 4.10: Solitary play

Photo 4.11: Parallel play

Photo 4.12: Cooperative play

In another observation, I noticed children were able to see that the child chose to play alone and was unaware of what he is doing as he was not even aware that he has moves from entire group in the classroom, though he was enjoying what he was doing. One can deduce, from Photo 4.10 that the child was not able or ready to share and socialise with others during play, as explained by Vygotsky's social constructivism theory (Section 2.2.1).

In another classroom, I observed children playing alongside others (Photo 4.11). Children noticed what others were doing, but continued with their own activity without disturbing anyone. The implication is that these children would have liked to be more involved with other players, but were perhaps unsure about how to execute some activities. This where the more knowledgeable other can mediate and scaffold for the child, so that the child can learn through play (Section 2.2.1.2).

I also observed cooperative play (Photo 4.12). Children demonstrated their uniqueness and different styles in interacting with others (Section 2.3.2). They were interested in both the activity and other children participating in cooperative play. This implies that, when a child starts playing with family members and friends, they, as the more knowledgeable others, must integrate other subjects, like life skills, into mathematics by, for instance, teaching them about sharing and winning and losing.

5.1.2 Teaching areas involve indoors for play-based mathematics

Photo 4.13: Numeracy area

Photo 4.14: Literacy area

Photo 4.15: Fantasy corner

Photographs 4.13–4.15 show different teaching areas for numeracy, literacy and fantasy. My observation is that the first area, for numeracy, displayed few resources. In this classroom I noticed a lack of resources for creating a conducive teaching and learning environment in the ECCE setting (Section 2.4.3.5; Irvin, 2017:3).

In the same classroom, I observed a literacy area (Photo 4.14). In this area, there were a few charts that integrated mathematical play-based learning on them. Generally, the practitioner showed limited understanding in this area. This implies that teacher development is required, and her content knowledge in the ECCE setting should be developed (Section 2.4.3.2).

In the fantasy area (Photo 4.15) I observed few teaching and learning resources. Resources such as clothes for different occupations and different genders were not available. In this area children were supposed to socialise, to communicate and learn different roles and how other resources, like food scales, work (Section 2.4.1.2). I also noticed that the area is not safe for children, as electrical cables were hanging on the wall, which could be dangerous for children. In the ECCE setting, safety is very important (Section 2.3.1; Ebrahim et al., 2011:388).

Photo 4.16: Mathematics area

Photo 4.17: Blocks area

Photo 4.18: Creative art area

Photos 4.16–4.18 display different corners that used recycled material (mathematics area, blocks area and creative art corner). In all these learning areas, the practitioner used recycled material to developed teaching and learning resources. For instance, ice-cream containers were used to sort items used to engage children in mathematical play-based learning (Figure 4.16).

In another learning area, I observed various shapes cut from planks/beams (Photo 4.17). Blocks of different sizes and shapes were painted in different colours. During the observation, children combined the blocks to make different patterns of different colours (Section 2.4.4.3). They also sorted the blocks according to shape and stacked them; they also counted the number of blocks of the same shape or size.

Art and creative was another area (Photo 4.18). The teacher used cans, which she had painted in different colours. With these tins, she demonstrated long, longer and longest. She folded paper strips and hung them using clothes hangers to teach the same concepts (lengths).

Photo 4.19: Outdoor equipment (swings)

Photo 4.20: Outdoor equipment (balance)

Photo 4.21: Climbing equipment

Photos 4.19–4.21 show the outdoor layouts I observed at three CBCs. Photo 4.19 shows a swing made of old tyres, and Photo 4.20 a few tyres planted in the ground. The equipment was not well maintained. The practitioner at that centre indicated that they needed a male employee to assist with painting and repairing broken equipment. This implies a lack of parental involvement, as one of the children's family members could assist in maintaining the school yard and outdoor equipment.

At another centre, most of the outdoor equipment was available, and the practitioner supervised the children and showed them how to use the equipment. However, there was no control in terms of age-appropriate equipment. The children played on all the equipment that was available, which I found risky and unsafe, as some young children fell while they were climbing.

I noticed beautifully painted tyres at another centre (Photo 4.21). Unfortunately, that was the only outdoor equipment that the children had for play. This means that there was a shortage of equipment that could be used for gross motor development, to supplement fine motor development – children have to be developed holistically.

4.8 SUMMARY OF DATA FROM THE JOURNAL ENTRY GUIDE

4.8.1 General data that emerged from the semi-structured interviews

Throughout the fieldwork, I used a journal to capture interesting and surprising moments that occurred and which were not captured in the articulations of practitioners during semi-structured interviews and classroom observation sessions. This data was aligned with themes and sub-themes, as indicated in Table 4.1.

During the interview sessions, when we discussed practitioners' lived mathematical play practices in the ECCE setting, showing love, care and respect came out strongly as the most important kind of practice that is expected of a teacher working in this environment. Through their focus on showing care and support, I noticed that they are passionate about their work and children. However, they lacked support and guidance on how to nurture children and enhance their numeracy skills in a playful manner. Mathematical play was another focal point that was mentioned often, though few practitioners were able to display and demonstrate how to engage children in such a way that children participated in all mathematics activities. In doing so, practitioners followed a daily programme, which I found in only in two CBCs, while other centres did the activities that they wanted to teach on a particular day. The NCF indicates that, in the ECCE setting, practitioners or caregivers should follow effective practices that have been planned and integrated, according to what is best for children's holistic development (DSD, 2015:2). Photo 4.22 depicts the daily programmes that were followed at some community-based centres.

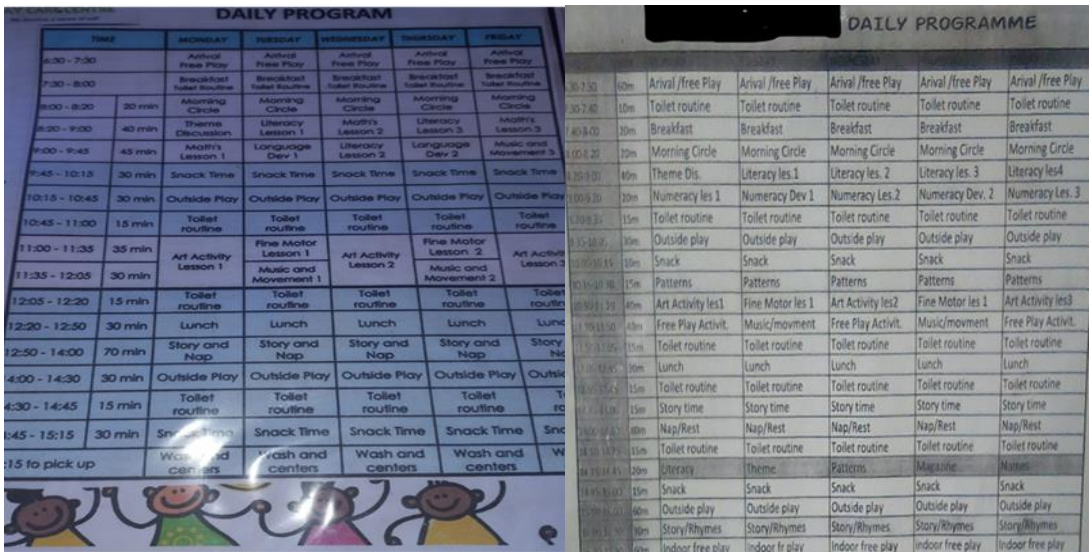


Photo 4.22: Daily programmes of CBCs A and B

In some instances, I realised that few practitioners contextualised what should happen in the ECCE setting. They spent most of the time ensuring that children aged three and four were able to write or trace properly on pictures and numbers. Some practitioners were expecting three-year-old children to write their names on pages, and seemed to have forgotten that writing development does not happen at that age, and that children should pass through several stages of writing skill development before they can write mathematical concepts and symbols. This implies that practitioners should encourage children to use shapes and patterns to communicate mathematics concepts. Figure 4.2 depicts the continuum stages of writing skill development (Phelps, Levy & Stannard, 2005).

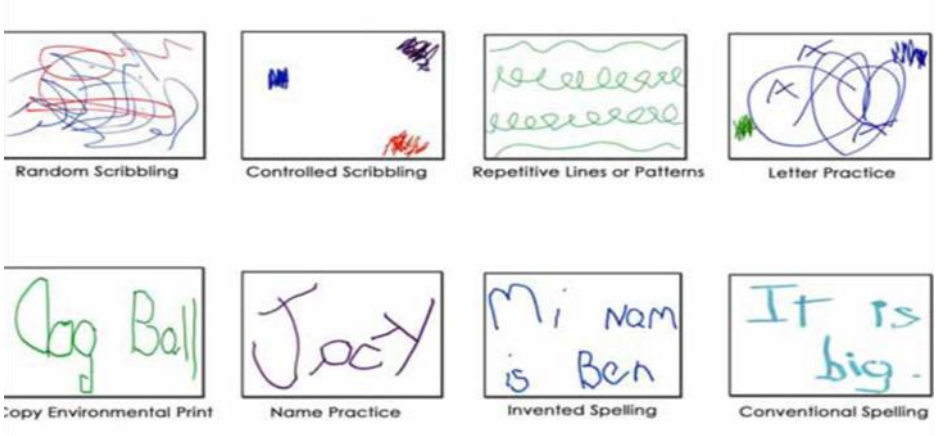


Figure 4.2: Continuum stages of writing skill development

Source: Adapted from Phelps et al. (2005)

I was unable to follow and see how the practitioners transited from one activity to another, especially between teacher-guided activity, child-guided activity and children's free play. I also found that they seldom aligned their activities with the NQF requirements for children from birth to 4 years old. This implies that practitioners lacked exposure to the prescribed curriculum, and those who had access to the document did not follow it. This implies they need to undergo teacher development, so that they know how to use the document appropriately (Section 2.4.3.2; Daries, 2017:16).

4.8.2 Practitioners' preparedness for teaching mathematical play in CBCs

Play-based mathematics requires practitioners to understand children who are from different contexts and to be well prepared before they engage children in mathematical play education in the ECCE setting. Regarding this theme, which also provided sub-theme 1.1, practitioners used various strategies, for instance play, discovery and games activities, during mathematical play education. Although various strategies were employed, the evidence is that most practitioners were struggling to apply an integrated approach that integrated all the subjects through play-based learning, particularly mathematics education. Use of the learner-centred approach was not always clear. In most cases, practitioners' lesson plans were presented in a traditional way of teaching, and practitioners were more active in mathematical play-based activities in which children were supposed to be more involved in those planned activities.

Additionally, I captured the practice of memorisation and reciting of information by children. At this stage, my understanding is that practitioners are supposed to mediate activities and provide scaffolding for children who are still struggling. I followed the daily programme that was approved by DBE and DSD that guided the practitioners on which activity should follow after the children completed the task given by their practitioner. I also observed how the practitioners catered for the diverse needs of their children in the classroom, so that all children could participate fully in all the planned mathematical play-based activities.

During observation sessions, I also checked how social constructivist theory is acknowledged by practitioners and how it links with the importance of social, cultural, and historical processes in the formation and development of the child, particularly in

mathematical education (*cf.* 2.2.1). I looked at how practitioners followed the routines in the daily programme and realised that they were still not sure of what to do and when to do a particular routine. Addressing children with special needs was another point that I noticed during the interviews, as none of the participants mentioned how they supported these children, and they had no plans in place to support children with barriers to learning and development.

5.1.3 Factors that may impact on practitioners' mathematical play practices in rural context

Regarding factors that may impact on practitioners' mathematical play, practitioners did not mention instability of children's enrolment in centres due to families moving from one informal settlement to another. By so doing, families were trying to move to an informal settlement with a well-established infrastructure and transportation, as some children have to walk long distances from their home to the CBC or the multi-grade classroom. I believe this is a key point in relation to factors that might impact teaching in general, and on practitioners' mathematical play practices in rural contexts. I was surprised to see that one CBC had only one classroom, built of bricks, with curtains to divide the space into 'classrooms' for different ages (see Photo 4.23). Outside, there was only one tyre, which the practitioner indicated was a sand play activity. It was not filled with sand, but contained ordinary soil. This implies that, even though the study was conducted in the urban area of Mangaung, there are still some centres that were characteristic of a rural context. This shows that we still have a long way to go to reach the required standard for ECCE settings.

Photo 4.23: Informal settlement classroom (left); outdoor play area (right)

In addition to inadequate physical facilities, these centres lacked adequately qualified practitioners, and faced high staff turnover and low retention rates for dedicated practitioners. This situation made it difficult for the ECCE practitioners to engage children in the mathematical play practices. This led me to believe that, though most participants agreed that they would be able to teach in ECCE settings in a rural context, they actually have no idea of the reality of rurality. This means that a variety of views would have emerged if the interviewed practitioners had truly understood the rural context.

4.8.3 Measures to ensure the proper mathematical play practices are used

Theme 5 in Table 4.6.1 relates to measures to ensure that the proper mathematical play practices are used. I employed observation and noted a number of interesting and surprising findings. I was interested to find that most practitioners mentioned a lack of resources to engage children in mathematical play-based learning. In some centres, practitioners were able use recycled materials to create teaching and learning tools for proper mathematical play practice. As shown in Photo 4.24, geometric shapes were made from a cardboard box, a numeracy chart with number pictures was made from magazine cut-outs, and big and small tyres were used in the play area. I deduced from what I saw that some practitioners managed without expensive teaching learning

materials, instead, they used the limited resources that they had at hand for the benefit of the children's mathematical play-based learning.

Photo 4.24: Shapes, numbers and outdoor area from recycles materials

I did fieldwork during COVID19 Level 3 lockdown and had to adhere to strict regulations. In my journal, I noted that some centres lacked sanitation and running water. These shortcomings did not hinder the children from using manipulatives during mathematical play. One of the centres provided the children with a container with a tap on the side, so that they could wash their hands before they touched the blocks or other toys, or after every routine in the classroom. At another centre, every table was mounted with a protective screen between the children, so that they could engage freely in play-based mathematics.

Photo 4.25: Water container (left) and table protective screen (right)

4.9 CHAPTER SUMMARY

In Chapter 4, I discussed the findings from data generated in the phenomenological study of practitioners' lived mathematical play practices in the ECCE setting. A thematic approach was used to analyse the data provided by participants who had been sampled in CBCs in the Motheo District of the Free State province. All themes were developed from data gathered in semi-structured interviews, through observations and from journal notes, which were the instruments employed to generate data (Section 4.6.1). Additionally, sub-themes emerged from the themes and helped to address the research question: What are practitioners' lived mathematical play practices in early childhood care and education settings?

The data that was gathered was presented and interpreted. Data from the observation reports enhanced the data generated during the semi-structured interviews. I also provided a summary of data from the journal entry guide. These findings were related to literature review (Section 2.1), to establish whether the empirical data confirms or refutes the findings of the study.

CHAPTER 5
FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

5.1 INTRODUCTION

This chapter will discuss the findings and conclusions based on the study data, and make recommendations and suggestions for further research, based on the theoretical framework and literature review discussed in Chapter 2 (see Sections 2.2 and 2.4), as well as the empirical data presented in Chapter 4. Throughout the course of the study, the empirical data sought to answer the following sub-research questions; answers to these questions would propose a solution to the main research question: What are practitioners' lived mathematical play practices in early childhood care and education settings? (See Section 1.6.)

1. What are the current lived mathematical play practice of practitioners in the CCE setting?
2. How do ECCE practitioners prepare the mathematical play environment in community-based centres?
3. What are the challenges faced in ensuring the proper mathematical play practices environment?
4. What are the factors that may impact on practitioners' mathematical play practices in a rural context?
5. What are the measures to ensure a proper mathematical play practices environment?

5.2 SUMMARY OF MAIN FINDINGS, CONCLUSIONS, RECOMMENDATION AND SUGGESTIONS FOR FURTHER RESEARCH

In this section, the findings and conclusions that were drawn from the empirical data will be discussed briefly. It was in the context of these findings and conclusions that recommendations to address the problem will be made. In following this process, the demographic information of the participants will be discussed, followed by the themes that emerged from data analysis, which were used as overarching guidelines to ensure that conclusions are drawn and valuable recommendations could be made. The

themes were the following: practitioners' lived mathematical play practices in ECCE settings; ECCE practitioners' preparedness for the mathematical play environment in CBCs; challenges impeding a proper mathematical play practice environment; factors that may impact on practitioners' mathematical play practices in the rural context; and measures that ensure the proper mathematical play practices in the ECCE setting.

5.2.1 Demographic information of the participants

As indicated in Table 4.1, which presents demographic details of participants, I used purposeful sampling and interviewed ten practitioners on their lived mathematical play practices in the ECCE setting. I looked at the following aspects of demographics of participants: context, gender, age, language spoken at the centre, qualification, and experience of the participants.

5.2.1.1 Contexts of the participants

The study was undertaken in CBCs that were located in informal settlements. This context was chosen because it was characterised by urban, disadvantaged human settlements. This had a direct effect on practitioners' lived mathematical play practices, particularly in the ECCE setting.

5.2.1.2 Gender of the participants

Ten practitioners were involved in the study as participants, all women. In South Africa, women play the mayor role in childrearing and development. There is also an assumption that the care and education of young children is women's work, so there were no male participants in the study.

5.2.1.3 Age of the participants

The participants' chronological age ranged from 29 to 47 years. The youngest practitioner's age was 29, four practitioners' ages ranged between 31 and 39, and the majority of the practitioners' ages ranged from 40 to 47. My assumption was that the older the practitioners in the ECCE setting, the more experienced they had.

5.2.1.4 Language spoken at the centre

The languages spoken in the ECCE setting in South Africa vary; in the case of the six centres in this study, English, Sesotho and Setswana were used; the latter two are

main languages spoken in Mangaung Only two CBCs used English. The language used might be due to an agreement between parents of the children and the centre, or it might be influenced by the language policy of a centre.

5.2.1.5 Qualifications of participants

As indicated in Table 4.2, out of ten participants, only one had completed a degree in foundation phase. One practitioner had Grade 11, which is lower than NQF Level 4. The majority of practitioners had obtained qualifications on Level 4, which is equivalent to Grade 12, and one had obtained a qualification on Level 5. Participants had obtained their qualifications through different organisations and institutions. Most of the practitioners blamed a lack of funding for their lack of qualifications to teach in the ECCE setting.

5.2.1.6 Experience of the participants in the ECCE centres

The years of experience of practitioners ranged from a minimum of one year to eight years. This indicates that practitioner had been in the centres more than a year and they should be able to engage children in mathematical play-based education in the ECCE setting. Despite their extensive experience of working at the ECCE centres, practitioners still faced challenges relating to inadequate qualifications, and a shortage of resources needed to increase children's knowledge of mathematics sufficiently so that they could enter formal education.

5.2.2 THEME 1: Practitioners' lived mathematical play practices in the ECCE setting

This section will provide a summary of the most important findings for sub-themes 1.1 to 1.5, which were generated from the data in the empirical study.

During the semi-structured interview sessions with the participants, they gave different responses to questions relating to their current practices in the ECCE setting (sub-theme 1.1). Regarding expectations, it was reported that practitioners who work with children should build relationships, show respect, have passion, be experienced and act in loco parentis. Practitioners seem to know and understand what was expected of them in ECCE, particularly regarding the teaching of mathematical play-based learning. They believed that they possessed these qualities, and applied them in their

interaction with young children. Children need more attention, and practitioners act as the first parents that children interact with outside their family circle. Hence, participants believed that they should assume and execute parental responsibilities, as they were interacting with children every day in the ECCE setting. This relates to the pronouncement made by the DBE (2015), that there is an urgent need to effect social transformation through integrated care and education for young children. This can only be done with well-prepared practitioners who can engage all children, and inspire them to fully participate in mathematical play-based learning.

The empirical study revealed that practitioners should ensure that they make learning enjoyable for all children, to inspire them to learn. It is through a child-centred approach that children will be able to take the lead and start to create new knowledge through interacting with others in the ECCE environment (see 2.2.1). By implementing an integrated learning approach and including in practitioners' lesson plans mathematics, life skills and languages, children can be assisted to learn through play, and can gradually be introduced to mathematics concepts and thinking strategies that support their learning. Hence, during mathematical play-based learning in the ECCE setting, practitioners are urged to provide children with manipulatives or mathematics resources, such as bocks and puzzles. By doing so, practitioners help children to comprehend mathematics concepts and see the concrete representations of these concepts in preparation for formal schooling.

It was also noted that scaffolding and mediation play a major role in mathematical play-based learning. The use of mediation during mathematical play-based learning assists children to perform tasks under the guidance of their practitioner, so that they learn how to do the task alone. Scaffolding is a good strategy, and was by implemented by practitioners to ensure that all children participated in mathematical play, while the knower assists children who are struggling with the task, so that they can catch up with their peers. Once the children were able to work on the task, this assistance was gradually withdrawn, so that children could work hands-on to execute the tasks assigned to them. This type of learning is labelled as child-directed learning or activity, as the children can take the lead in their learning of mathematics.

The fact is that, in ECCE settings all over the world, practitioners are required to plan developmentally appropriate play-based learning. This implies they should base their

practice on the ages and the needs of children. During the empirical study, it became clear that practitioners mostly embraced the current approach of teaching children according to their age groups, and ensured that all children were developed holistically (Makeleni, 2018:40). The practitioners believed that, if they did not plan for children of different ages, they would be unable to improve their teaching and fail to come up with new ideas that will assist the practitioners to communicate mathematics concepts effectively to the children. Planning was seen as good strategy to find out and understand which children were lagging behind or struggling, and who were progressing and needed to be accelerated, particularly in mathematical play-based learning.

5.2.3 THEME 2: ECCE practitioners' preparedness for the mathematical play environment in CBCs

I described the data generated on theme 2 and the five related sub-themes. The subthemes that emerged from this theme indicate that planning helps practitioners to determine which activities are relevant for a certain age group, and helps them to adjust their teaching strategies and get to know their children better.

When responding to this theme, participants agreed that, in order for them to be well prepared for engaging children in mathematical play at the CBCs, they needed resources and infrastructure to help them teach effectively. They also articulated that, even though they were able to display their teaching areas – reading, creative art, educational toys, blocks as well and puzzles – some of the schools were not in a position to have such areas due to financial and space constraints. In most cases, they packed different resources on shelves or used the carpet to improvise for all the areas, to ensure that children were able to engage in play-based learning. However, despite having to employ these strategies, practitioners remained positive and made use of the resources at their disposal to ensure that teaching takes place in the ECCE setting, and that children acquire knowledge of mathematics through play-based learning and methods.

Participants reported that they employed various approaches in order to address the diverse needs of all the children in their respective ECCE settings. I noted that, through visual, auditory and kinaesthetic methods, practitioners ensured that children were in a position to understand mathematics education while seeing, hearing and using their

body parts to touch and manipulate some of the objects that relate to mathematical play-based learning in the classroom. Participants also revealed that they lacked the knowledge and skills to work with children who have learning barriers; they have not been trained on how to deal with such children. The study found that practitioners needed more assistance to improve their capabilities of working in an inclusive environment; such training will help them to address the diverse needs of all children in the ECCE setting. Such competencies will develop practitioners' confidence in implementing a learner-centred approach that could contribute to children constructing new knowledge in mathematics education. It is evident that this will happen if there are teacher development programmes for practitioners in the ECCE setting, as a focal point for teaching and learning (Chuta, 2018:57).

Practitioners in the study were also aware that they were not adequately trained to teach in the ECCE setting. They had expected to be provided with additional guidance and support, in the form of workshops that included documentation or guidelines to supplement play-based learning. It appeared that practitioners lacked the confidence to learn on their own and teach through mathematical play-based learning, and relied on knowledgeable colleagues to guide them on how to approach mathematical play in the ECCE setting. Some practitioners had been trained by NGOs, but there were no follow-up sessions or monitoring to ensure that mathematical play-based learning was implemented effectively in the ECCE setting. It came to my attention that each practitioner in each selected ECCE centre used teaching strategies and documents that suited them. There was no uniformity in terms of what to teach and when to teach children certain mathematics concepts. Each practitioner had her own perceptions and beliefs about employing an integrated lesson plan, particularly in mathematical play-based learning.

5.2.4 THEME 3: Challenges impeding a proper mathematical play practice environment

This theme highlights the challenges that impeded practitioners in implementing proper mathematical play practices in the ECCE environment. I explored these challenges from a phenomenological research design, which assisted me to capture the responses of participants during the semi-structured interviews, where they revealed that there was a shortage of indoor and outdoor resources, and infrastructure

in general. It was noted that that practitioners were not adequately qualified and there was a lack of support from the DSD and DoE, as custodians of the ECCE centres.

During the interviews, regarding teaching play-based mathematics, practitioners raised the concern that they lack space to engage children with mathematical activities. Spatial constraints also prevented children from expressing themselves in their own languages, as they had limited interaction with other children in the classroom. Practitioners also lacked training to teach children who faced learning barriers and who were enrolled in their classes. This made it difficult for practitioners to ensure that all children participated in play-based mathematics learning. It is evident that, for proper mathematics play-based learning to be implemented, there should be a teacher who could assist children who had learning problems. Furthermore, the scarcity of resources came through strongly through participants' responses and my observations, and was found to be common challenge that affected most of the ECCE centres. The empirical study revealed that a lack of space and infrastructure in the indoor and outdoor areas hampered practitioners who wished to engage children in mathematical play-based education. Most of the ECCE centres lacked basic facilities such as running water, sanitation and electricity. Such poor infrastructure not only presents a health risk to children, but it also prevents practitioners from engaging children in mathematical play-based learning, which impacts quality teaching and learning of mathematics in the early years.

It was interesting that a participant mentioned that the shortage of male employees in the ECCE setting was a problem. This shortage caused challenges for practitioners, as they do not have time or skills to do repairs themselves (they are teachers, not handymen). As a result, the school needed a dedicated person to do repairs to ensure that practitioners are dealing with teaching and learning; sometimes, such maintenance or repairs of outdoor and indoor equipment consumed time needed for teaching during mathematical play-based learning. Practitioners believed that having a man as employee on contract to do repair, would help the centre to save money, as this employee would only work as a factotum part time.

In the study, I found that, though practitioners have qualifications, these qualifications are mostly at NQF Levels 4 and 5, and had been obtained from NGOs and the local TVET college (see Table 4.1). These qualifications were not sufficient for teaching in

the ECCE setting, and practitioners still experienced challenges when planning for implementing the integrated learning approach that is required in this environment, particularly for mathematical play-based learning. A lack of adequate qualifications affected practitioners' engagement with children in play-based learning, because practitioners lacked knowledge, and they were unable to plan and teach the children effectively.

Drawing from Vygotsky's ZPD, practitioners, as the knowledgeable other, are responsible for providing support and developing children's mathematics skills in the indoor and outdoor play areas. The ZPD is regarded as the place where interaction and socialisation of the child with the practitioner and the environment occurs. In the study, it was found that only one out of ten practitioners were adequately qualified, though she was underpaid. It clear that, in the ECCE centre in general, funding determines practitioners' career paths, as they earn little and are unable to improve or reskill their qualifications to required levels.

Another factor that was found to be an overarching impediment, and which lead to low-quality mathematical play-based learning, was the lack of support provided by the DSD and DoE. Few practitioners were trained and funded, and there was no on-site monitoring and support in the form of professional development programmes. These shortcomings hindered progress in the implementation of quality mathematics education in the ECCE setting. The roles of both the DSD and DoE were found to be unclear in terms of the support they should provide, which impacted practitioners' mathematical play practices in the rural context.

5.2.5 THEME 4: Factors that may impact on practitioners' mathematical play practices in the rural context

The empirical study found that practitioners agreed that all children have the right to learn, despite the environment in which they live. The study also revealed that it is important that children in a rural ECCE setting should be provided with the same opportunities for learning as children who live in urban areas. Access to high-quality childcare and education is still limited in most rural areas, which means that rural children are left behind in terms of education opportunities.

It was mentioned that children in rural areas could be taught in the same way as in urban areas. There was a belief that using the limited resources that are at practitioners' disposal could enable the creation of something of interest for children to learn through mathematical play. Applying these resources will give rural children some experience through the use of kinaesthetic and concrete approaches during the teaching and learning of mathematical play-based practices.

In some instances, practitioners reported that they would be uncomfortable to teach in a rural ECCE setting. Practitioners reported that they would find it difficult to work in diverse rural communities, and believed that it would be impossible to teach different grades and age groups under one roof. They believed there should be different planning for each grade, which will require more time, and it would be difficult to transit from one grade activity to another. They questioned the possibility of using the same resources for different grades and phases, as this might create confusion for children, as their level of thinking varies widely. It was clear that some practitioners preferred mono-grade teaching, which involves teaching one grade for the purpose classroom of management and planning. The reality was that a shortage of teachers and classrooms lead to overcrowding and the practice of multi-grade classrooms – even in peri-urban, areas this challenge still exists.

The majority of participants agreed that children growing up in rural communities can also perform well academically and succeed in their careers. The belief was that, if rural children were stimulated and provided with the same teaching and learning experiences as urban children, the challenges in rural areas could be overcome. The empirical study found that practitioners believed that a child who gets the right support, regardless of where they grow up, will excel, just like any other child, despite the geographical area. The study found that technology in rural areas is lacking, though the new generation of learners makes excellent progress with career development if they are exposed to technology, regardless of where they live. Another finding was that transport for children between their homes and rural schools would be helpful to ensure rural children get an equal education. Lack of funding was emphasised by the participants, who reported that, if there is no funding, none of their plans to implement mathematical play-based learning in the rural setting could succeed.

5.2.6 THEME 5: Measures that ensure the proper mathematical play practices in the ECCE setting

The findings indicate that participants had different views on sustaining academic performance from mathematical play-based learning. Motivating children by engaging them in mathematical play was found to be a good intervention that could sustain children's academic performance. Using resources to keep children active at all times was also recommended, for instance, tools for indicating rhythm and tempo, as music is regarded as a way to sustain and encourage children to learn. The empirical study found that multiple interventions could be relevant to mathematical play-based learning. Different stakeholders, such as policymakers, government, ECCE organisations, NGO and parents, should work together to support children to engage in mathematical play-based learning in the ECCE setting.

Practitioners are responsible for engaging children and improving their understanding of mathematics in the early years. Practitioners in the study possessed limited content and pedagogical knowledge, because they lacked adequate qualifications, and because there are few teacher development programmes. However, some practitioners were proactive and prepared lessons that included diverse learners in mathematical play-based activities, and presented their lessons in such a way that it was easy for children to understand. The empirical study showed that, in order for practitioners to enhance their content knowledge, a creative and learner-centred approach was to engage in mediation and scaffolding in mathematical play-based learning in the ECCE setting.

Participants reported sharing ideas for activities that parents can implement at home to enhance their children's mathematical play-based learning. The empirical study revealed that parents can assist their children to learn mathematics by buying mathematics games and involving children in compiling shopping lists and other activities that teach children how to count and, most importantly helping their children with homework and other school projects. To enhance children's understanding of geometrical shapes, the study revealed that showing or asking children to identify different shapes they see around the house could be a useful way for parents to teach the concept of different shapes. To ensure children understand the concept of fractions, the study revealed that cutting vegetables and fruits in halves and quarters

could be a valuable way for parents to teach their children about fractions through play at home.

In addition, the participants recommended inviting parents to be involved in the school, visiting the school to tell the children stories related to mathematics. This activity could help to improve children's communication skills and develop children holistically, as members of the community. The empirical study revealed that collecting recyclable materials, such as ice-cream sticks and bottle tops of different colours could be useful, as the items could be used to teach children to count and sort during mathematical play-based learning.

5.3 RECOMMENDATIONS

- The practitioners believed that learning and stimulation should always take place to enhance children's full participation in mathematical play-based learning.
- During play-based mathematics, practitioners should employ early learning and development areas and integrate competency, learning, development and guidance of the teacher. This will ensure uniformity of what is taught at all the ECCE centres of one district and municipality, and prevent each centre from implementing their own curriculum.
- Most higher education institutions offer a Diploma in Grade R teaching, and the degree B Ed Foundation Phase; however, no institution has professionalised ECCE qualifications. This leaves most of practitioners without knowledge on how to work and teach the correct curriculum content for children aged three to four years old. Initiatives like this would be very important for the national higher education department, which is responsible for awarding qualifications and reskilling practitioners.
- In due course, the DSD and the DoE will have to clarify their roles and responsibilities, so that practitioners have a clear understanding of what is happening at each department and what they should expect from them. In this way, practitioners could access all the services rendered by those two departments, as the custodians of ECCE.

- The DoE should train practitioners to identify children faced with learning barriers. Strategies should be developed to make identification uniform at all ECCE centres.
- The local university could offer a qualification that is intended for ECCE practitioners. This qualification should incorporate curriculum content that should be taught to children in this environment.
- In present study, the appointment of men in ECCE centres, as a practitioners or a general workers, could play a major role in children's development and education.
- Parents should take a charge of and apply all the advice and strategies to help their children learn mathematics that were suggested during the interviews with participants. In this way parents could engage their children in mathematical play-based learning at home and also find out what mathematical play-based education involves.

5.4 LIMITATIONS OF THE STUDY

This study is limited as a result of the small amount of data it generated. Due to the nature of the study, it took place in Motheo District in Mangaung, which has characteristics of both urban and rural communities. The study was confined to a particular geographical area and excluded the four other districts of the province. Therefore, data was collected from a small sample, with the result that findings cannot be generalised. Additionally, the study was conducted with only female practitioners, and needs to be expanded to other centres to gain more insight into knowledge and conceptualisation of the ECCE setting.

5.5 AREAS FOR FURTHER STUDY

- Additional research needs to be conducted on ECCE practitioners' connection with their mathematical play-based practices in the ECCE setting. This study could be reproduced, and involve a different sample of participants with more knowledge on mathematical play-based learning. Continuing this study with a different set of interview questions might yield additional results.
- Different and similar studies could make an important contribution to understanding why South African rural communities do not receive the same

services as urban communities. This inequity causes a disparity, and further research could investigate the reasons for this inequality, as all children have the right to learn.

- Practitioners found it difficult to prepare developmentally appropriate practices and were unsure how to integrate all the subjects – mathematical play, language, and life skills – into one theme. This inability was the result of practitioners' inadequate qualifications, and limited training and workshops.
- My observation about parallel and solidarity play indicates is that there was a lack of child-to-child interaction; children displayed an inability to know about and understand mathematical play-based learning. I recommend further research into socialisation with others, as supported by Vygotsky (1978).

5.6 CONTRIBUTION TO EXPANSION OF KNOWLEDGE IN THE FIELD OF ECCE

- It is my view that the root of the problem areas identified and discussed in this study in relation to factors that influence the implementation of mathematical play-based learning, is that language should serve as a tool to assist practitioners to mediate and scaffold in order to meet children's diverse needs.
- Teaching and learning resources could be useful for closing the gap between what children should learn and how they should learn. The limited availability of resources at the children's disposal could explain why children are struggling to understand mathematics concepts.
- The study contributes to ensuring that, to learn optimally, it is vital to consider children's contexts in terms of safety, to ensure that the environment is conducive to learning, and that teaching and learning should be characterised by love, passion and care by practitioners, so as to stimulate children's mathematical play-based learning.
- The study contributes regarding the identification of children who experience barriers to learning and development. It was evident that practitioners encountered challenges, which could be result of their teaching methods, or could be caused by the language of teaching and learning. The study was conducted in three different informal settlements, where various languages

were in use, and it may be that a child was enrolled in an ECEC that used a different language to the one used the child's home, due to proximity.

5.7 OVERVIEW OF THE STUDY

As indicated in Section 5.1, this study set out to respond to the question: What are practitioners' lived mathematical play practices in early childhood care and education settings? The study was conducted in Motheo district only, to obtain an understanding of the way practitioners prepared themselves when engaging children in mathematical play-based learning. The results of the study are reported in five chapters, as follows.

Chapter 1 introduced the study topic, background to the study, the problem statement, rationale for the study, the specific objectives, the main research question, delimitations of the study and the operational concept that was used throughout the study. Additionally, literature on the theoretical framework guiding the study was reviewed. This chapter also discussed ECCE in context, mathematics in ECCE, and the discourse on the concept of play and mathematical play. Furthermore, empirical studies highlighting the importance of play, perceptions of lived play practices of ECCE practitioners, challenges practitioners face when they adopt play in ECCE mathematics learning, and strategies for improving practitioners' use of play practice in ECCE learning were reviewed.

Chapter 2 provided a logical presentation of the theoretical framework in relation to its origin, its importance, and its relevance to the study. Furthermore, the chapter reviewed literature from global to local perspectives, focusing on the concept of ECCE, mathematics learning in ECCE, and discourse on the concepts of play and mathematical play. In addition, the chapter reviewed empirical studies that report on the importance of play in ECCE mathematics learning, perceptions of lived play practices of ECCE practitioners, challenges practitioners face when they adopt play in ECCE mathematics, strategies for improving practitioners' use of play practice in ECCE learning, and, lastly, a summary of the preliminary literature review.

Chapter 3 comprised an introduction to the research methodology, and a description of the research paradigm, the research approach, the design of the study, and the study site. Furthermore, the chapter scrutinised the selection of the participants, data collection instruments, and credibility, including trustworthiness. The chapter,

furthermore, discussed data collection procedures using the triangulation technique, analysis procedures, and findings. The chapter concluded with a discussion on ethical considerations and processes, namely gaining entry, participants' rights, informed consent, confidentiality, and protection from harm. Maintaining participants' anonymity and the researcher's professionalism, as well as protection of participants' vulnerability, were discussed in detail.

Chapter 4 presented the data that had been generated in a systemic way, through the use of themes and sub-themes, as indicated in Section 4.1. This is followed by an analysis and interpretation of the data generated from the semi-structured interviews, observations in class and the researcher's journal notes. Furthermore, the chapter discussed the analysis and interpretation of data and findings in relation to the literature and the research problem.

Chapter 5 includes a summary of the important findings, recommendations, limitations, and further research suggestions, the study contribution to the expansion of knowledge, as well as an overview of the study, and a conclusion.

5.8 CONCLUSION

The study intended to provide an overview of practitioners' lived mathematical play practices in ECC settings. I considered the objectives of the study and aligned them with the comments and contributions of the participants during the semi-structured interviews. I ensured that the study incorporated the data obtained from the observations I did, and journal notes that I drafted during the fieldwork, in order to address the main research question: What are practitioners' lived mathematical play practices in ECCE settings? Recommendations were made in accordance with the findings, which, in turn, informed the conclusion of this study.

This study found that, in South Africa and in other countries in the world, children are more active and involved in learning activities that use play. Children are freer if they are guided and provided with opportunities to learn and explore through mathematical play, through the mediation and guidance of an adult. Unfortunately, this study identified a number of constraints that prevent practitioners from engaging children in mathematical play. These constraints are not peculiar to South Africa, but are experienced in other countries too. Despite these challenges, the study confirms that

children learn more easily through play, they communicate with each other and become socialised through their environment. The study shows that, even though there are constraints in the ECCE setting, practitioners are prepared to take the lead and contribute and work to achieve the holistic development of children, particularly regarding mathematics education.

The key finding of the study is that practitioners are still not adequately qualified to teach in the ECCE setting. Furthermore, local higher education institutions are still not ready to offer further professional development for practitioners. The role and responsibilities of the two sister departments – DSD and DoE – are still not clear to ECCE centres, especially regarding the new developments on function shifts. These are some of the constraints that are affecting both practitioners and children who need to be prepared to attend formal school. It is imperative that, when there are changes, policymakers must ensure that all the stakeholders of education are on board. Moreover, the findings also reveal that a lack of training, monitoring, and support for practitioners stand in the way of practitioners engaging children in mathematical play-based learning, which leads to poor performance of learners in mathematics in the higher grades. This problem needs attention as early on as possible, that is, in the ECCE setting.

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APPENDICES

APPENDIX A: ETHICAL CLEARANCE

UNIVERSITY OF THE FREE STATE
UFS UV

GENERAL/HUMAN RESEARCH ETHICS COMMITTEE (GHREC)

15-Mar-2021

Dear Mrs Seipati Baloyi-Mothibeli

Application Approved

Research Project Title:
PHENOMENOLOGICAL STUDY OF PRACTITIONERS' LIVED MATHEMATICAL PLAY PRACTICES IN EARLY CHILDHOOD CARE AND EDUCATION SETTING

Ethical Clearance number:
UFS-HSD2020/1970/153

We are pleased to inform you that your application for ethical clearance has been approved. Your ethical clearance is valid for twelve (12) months from the date of issue. We request that any changes that may take place during the course of your study/research project be submitted to the ethics office to ensure ethical transparency. furthermore, you are requested to submit the final report of your study/research project to the ethics office. Should you require more time to complete this research, please apply for an extension. Thank you for submitting your proposal for ethical clearance; we wish you the best of luck and success with your research.

Yours sincerely

Dr Adri Du Plessis
Chairperson: General/Human Research Ethics Committee

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APPENDIX B: REQUEST FOR PERMISSION TO CONDUCT RESEARCH IN THE COMMUNITY-BASED CENTRES REGISTERED WITH DEPARTMENT OF SOCIAL DEVELOPMENT

THE SUPERINTENDENT GENERAL

Free State Department of Social Development

Civilia Building 6th floor

Elizabeth Street

Bloemfontein

9300

Dear Sir/Madam

My name is Seipati Lydia Baloyi-Mothibeli and a PhD student and a Junior Lecturer at the Faculty of Education in the School of Social Sciences and Language Education. I hereby request a permission to conduct a research in the community-based centres in Mangaung Township.

DATE:

AUGUST 2021

TITLE OF THE RESEARCH PROJECT

PHENOMENOLOGICAL STUDY OF PRACTITIONERS' LIVED MATHEMATICAL PLAY PRACTICES IN EARLY CHILDHOOD CARE AND EDUCATION SETTING

PRINCIPLE INVESTIGATOR / RESEARCHER(S) NAME(S) AND CONTACT NUMBER(S):

Seipati Lydia Baloyi-Mothibeli 20101170 0845001269 / 051 401 2709

FACULTY AND DEPARTMENT:

Faculty of Education

School of Social Sciences and Language Education

STUDY LEADER(S) NAME AND CONTACT NUMBER:

Professor Chinedu Ifedi Okeke (UFS staff member)

Contact 051 401 2377 l 0730348602

WHAT IS THE AIM / PURPOSE OF THE STUDY?

The aim of the study is to carry out a phenomenological study of practitioners' lived mathematical play practices in early childhood care and education setting.

WHO IS DOING THE RESEARCH?

My name is Seipati Lydia Baloyi-Mothibeli and a PhD student as well a Junior Lecturer at the Faculty of Education in the School of Social Sciences and Language Education. I became aware that practitioners are struggling to contextualize ECCE setting which mostly involves play. Practitioners have challenges when implementing and integrating play in early mathematics in order to improve mathematics in higher Grades. This research intends to generate evidence on what practitioners do during mathematical play and how they engage children in mathematical play learning. It is hoped that this study will be of benefit to policymakers and curriculum developers in the area of ECCE and assist ECCE practitioners to enhance their practices and their strategies when engaging young children in play-based mathematics.

HAS THE STUDY RECEIVED ETHICAL APPROVAL?

Yes

Approval number: UFS-HSD2020/1970/153

WHY ARE YOUR INSTITUTION/ORGANISATION/COMPANY INVITED TO TAKE PART IN THIS RESEARCH PROJECT?

I chose 10 (ten) participants from 5 selected community-based centres. These will be practitioners who works directly with young children from birth to four years old. That is two participants will be identified at each centre to participate in the research. One

participant will be responsible for teaching 3 (three) years old children another one will be for 4 (four) years old children. I will contact Department of Social Development and request list of the community-based centres, publicly and privately owned. The list will have a full detail that include the name of the centre and the address where the centre is located, the name of the principal or centre manager and the contact details of the centre number of practitioners employed in the centre as well as number of children and how they are grouped in their classrooms in terms of their age. One participant will be responsible for teaching 3 (three) years old children another one will be for 4 (four) years old children. I will contact Department of Social Development and request list of the community-based centres, publicly and privately owned. The list will have a full detail that include the name of the centre and the address where the centre is located, the name of the principal or centre manager and the contact details of the centre number of practitioners employed in the centre as well as number of children and how they are grouped in their classrooms in terms of age. I chose 12 (twelve) participants from 6 selected community-based centres. These will be practitioners who works directly with young children from birth to four years old. That is two participants will be identified at each centre to participate in the rese

WHAT IS THE NATURE OF PARTICIPATION IN THIS STUDY?

The role of the participants will be to participate in the semi-structured interviews and be involved in the intensive observations where I will focus on practitioners' lived mathematical play practices in early childhood care and education setting. The question that will be asked will involve critical thinking about their practices and experiences in mathematical education, describing their strategies to enhance mathematical play and explain how that mitigate the challenges that might impede their own mathematical play practices in the ECCE setting. This process will take ± 3 months and the and while the interviews will take approximately 45 to 60 minutes per participants. I will minimise harm and risks that might hamper the full participation of the participants and ensure that they benefit optimally from participating in the study. In this study. I will ensure that none of participants will be exposed to any form of harm by not asking private and sensitive questions, thus, to preserve an atmosphere of serenity and safety throughout the sessions that will be asked and involve critical thinking about their practices and experiences in mathematical education, describing their strategies to enhance mathematical play and explain how that mitigate the

challenges that might impede their own mathematical play practices in the ECCE setting. The role of the participants will be to participate in the semi-structured interviews and be involved in the intensive observations where I will focus on practitioners' lived mathematical play practices in early childhood care and education setting.

WHAT ARE THE POTENTIAL BENEFITS OF TAKING PART IN THIS STUDY?

Taking part in this study will bring rich and contextualized knowledge of mathematical play in various ways as participants will bring their different viewpoints/contributions to the success of the research. They will be able to understand the role that they should play in integrating play in mathematical education. They will be able to contribute to the teaching and learning of mathematical play; how practitioners incorporate different types and stages of play, and the provisioning of opportunities for children to learn in the ECCE setting. They will be involved in the effective planning and implementation of the programmes to enrich mathematical play in the ECCE sector. I will always ensure confidentiality throughout the study when practitioners are integrating play-based learning in mathematical education.

WHAT ARE THE POTENTIAL RISKS TAKING PART IN THIS STUDY?

The research participants will comprise of different practitioners with different educational background, some participants may not see themselves fit for this research and as a result could not feel free to ask questions or give their inputs, I will not penalised them for not contributing or responding to the questions. Another anticipated inconvenience could be the aftercare classes where parents are collecting their children late after work. This may impact on the interview schedule for participants as interviews will take place after school when all children are left, and they may be delay in this process. If the research takes place in the multi-graded classroom, the researcher will have to wait until the teachers is working with the target children then starts to observer the practitioner's live mathematical play practices in the ECCE setting. Should we find ourselves in the COVID19 situation during the research schedule, rules and regulations of COVID19 will be followed. I will also

anticipate inconvenience that could be aftercare classes where parents are collecting their children late after work. This may impact on the interview schedule for participants as interviews will take place after school when all children are left, and they may be delay in this process.

WILL THE INFORMATION BE KEPT CONFIDENCIAL?

From the beginning on the consent form, I will clearly inform the participants that confidentiality, respect and privacy will be maintained throughout the study. Participants will be requested not to mention their identity in any of the study documents to avoid linking their personal responses and the participants will be assigned pseudonym and their names will be known by me only.

I will use the data and photos solely for the research purpose and pseudonyms will be used for identity purposes. The information gathered from the study, including hard copies will be used securely and kept confidentially in the strong room with the encrypted password known to me only. The participants' names will not be disclosed, and the responses made will not be linked to the participant's real name so that no connection will be made to the participants' responses. The collected data will be available to the participants on request and the Research Ethics Committee. I will also obtain the participants concern to utilise the collected data for other purposes including research presentations, educational conferences, educational articles and further research study. In order to maintain confidentiality, a confidentiality agreement will be drawn, communicated and signed between myself and participants. Encrypted password known to me only will be used to ensure the safety of the data generated during field work.

HOW WILL THE INFORMATION BE STORED AND ULTIMATELY DESTROYED?

I will keep the data in I will keep the data in a strong room with a password known to me only. All the interview recording devices where the data is stored, hard and electronic copies will be kept securely and be accessed by myself and the university personnel for future academic purposes while the electronic data will be stored and secured by a password on a computer which will change every three months. After a certain period, the information will be permanently destroyed on hard copies and electronic devices deleted from the sources. Data will be kept for future academic

purposes while the electronic data will be stored and secured by a password on a computer which will change every three months.

WILL THERE BE PAYMENT OR ANY INCENTIVES FOR PARTICPATING IN THIS STUDY?

There will be no payment, or any form of incentive offered to participants to take part in the study. The participants will be encouraged to participate willing in the research since its success will be beneficial to me, participants and the community at large. If the participants may decide to seek for more information regarding the research matter, they will be allowed to do so voluntarily, without assistance of payment or any incentive.

HOW WILL THE INSTITUTION / ORGANISATION / COMPANY BE INFORMED OF THE FINDINGS / RESULTS OF THE STUDY?

The final research findings of the research can be obtained on request from me or the research promoter. Should there be any queries on the way the research proceedings were conducted, you can contact this research promoter: Professor Chinedu Okeke, contact numbers: 051 401 2377/0730348602 or email address: OkekeCO@ufs.ac.za. Myself Seipati Baloyi-Mothibeli my contact numbers: 0845001269 or my email address SeipatiB@dut.ac.za for any information relating to this research and the research findings will be accessible for six months.

Yours sincerely

Seipati Lydia Baloyi-Mothibeli

APPENDIX C: PERMISSION TO CONDUCT RESEARCH FROM FREE STATE DEPARTMENT OF SOCIAL DEVELOPMENT

social development
Department of Social Development
FREE STATE PROVINCE

OFFICE OF THE HEAD OF DEPARTMENT

University of the Free State
Faculty of Education
Attention: Mrs. Seipati Baloyi-Mothibedi
Nelson Mandela Drive
BLOEMFONTEIN

Per email: BaloyiMothibeliSL@ufs.ac.za

Dear Mrs. Baloyi-Mothibedi

REQUEST FOR PERMISSION TO CONDUCT RESEARCH AT EARLY CHILDHOOD DEVELOPMENT BASED CENTRES

1. Your letter of request to conduct research dated 04/02/2021 in the ECD community based centres is hereby received as well as the conditional approval to conduct research granted by the Chairperson of the General/Human Research Ethics Committee is acknowledged.

2. The Department is very delighted with the initiative that would have its benefits in years to come, as we all know that the first 1000 days of a child are critical, the technique to involve practitioners in the study is supported. This research is also relevant in that it comes at the time when there is already a pronouncement to migrate ECD from Department of Social Development to the Department of Basic Education.

3. As stated by the Ethics committee, the research is ethically sound. Based on this observation, ***your request is hereby acceded to,*** the Department supports the study and wishes you all the best especially since the focus will be on improving the teaching of Mathematics in ECD.

4. Remember to always comply with COVID-19 protocols regardless of Alert levels at the time of conducting the study.

5. Any further questioning can be done through the Director: Children, Mr LT Tladi @ 066 015 9086.

Regards

ADV. TJ RHAHLO
ACTING HEAD: DEPARTMENT OF SOCIAL DEVELOPMENT

09/03/2021
DATE

Office of the Head of Department
Private bag X20616, Bloemfontein, 9300
Standard Bank Building, 2nd Floor, Cnr West Burger & Charlotte Maxeke Streets, Standard Bank Building
Email: hodpa@fssocdev.gov.za

APPENDIX D: REQUEST FOR PERMISSION TO CONDUCT RESEARCH IN YOUR COMMUNITY BASED CENTRES

THE PRINCIPAL / CENTRE MANAGER

……

……

Bloemfontein

9300

Dear Sir/Madam Sir/Madam

My name is Seipati Lydia Baloyi-Mothibeli and a PhD student and a Junior Lecturer at the Faculty of Education in the School of Social Sciences and Language Education. I hereby request a permission to conduct a research your community-based centres in Mangaung.

DATE:

August 2021

TITLE OF THE RESEARCH PROJECT

PHENOMENOLOGICAL STUDY OF PRACTITIONERS' LIVED MATHEMATICAL PLAY PRACTICES IN EARLY CHILDHOOD CARE AND EDUCATION SETTING

PRINCIPAL INVESTIGATOR / RESEARCHER(S) NAME(S) AND CONTACT NUMBER(S):

Seipati Lydia Baloyi-Mothibeli 201011770 0845001269

FACULTY AND DEPARTMENT:

Faculty of Education

School of Social Sciences and Language Education

STUDY LEADER(S) NAME AND CONTACT NUMBER:

Professor Chinedu Ifedi Okeke (UFS staff member)

Contact 051 401 2377 l 0730348602

WHAT IS THE AIM / PURPOSE OF THE STUDY?

The aim of the study is to carry out a phenomenological study of practitioners' lived mathematical play practices in early childhood care and education setting.

WHO IS DOING THE RESEARCH?

My name is Seipati Lydia Baloyi-Mothibeli and a PhD student and a Junior Lecturer at the Faculty of Education in the School of Social Sciences and Language Education. I became aware that practitioners are struggling to contextualize ECCE setting which mostly involve play. Practitioners are challenged when implementing and integrating play in early mathematics in order to improve mathematics performance in higher Grades. My intention in this research is to generate evidence on what practitioners do and how they engage children in mathematical play. It is hoped that this study will be of benefit to policymakers and to curriculum developers in the area of ECCE and assist ECCE practitioners to enhance their practices and their strategies when engaging young children in play-based mathematics.

HAS THE STUDY RECEIVED ETHICAL APPROVAL?

Yes

Approval number: UFS-HSD2020/1970/153

WHY ARE YOUR INSTITUTION/ORGANISATION/COMPANY INVITED TO TAKE PART IN THIS RESEARCH PROJECT?

I chose 2 (two) participants from your five community-based centres. These will be practitioners who works directly with young children from birth to four years old. One participant will be responsible for teaching 3 (three) years old children another one will be for 4 (four) years old children. I have selected your community-based centre randomly from the list of community-based centres, publicly and privately owned, from the list obtained from Free State Department of Social Development.

WHAT IS THE NATURE OF PARTICIPATION IN THIS STUDY?

The role of the participants will be to participate in the semi-structured interviews and be involve in the intensive observations where I will focus on practitioners' lived mathematical play practices in early childhood care and education setting. The question that will be asked will involve critical thinking about their practices and experiences in mathematical education, describing their strategies to enhance mathematical play and explain how they mitigate the challenges that may impede their own mathematical play practices in the ECCE setting. This process will take ± 3 months and the and while the interviews will take approximately 45 to 60 minutes per participants. I will minimise harm and risks that might hamper the full participation of the participants and ensure that they benefit optimally from participating in the study. In this study. I will ensure that none of participants will be exposed to any form of harm by not asking private and sensitive questions, thus, to preserve an atmosphere of serenity and safety throughout the sessions that will be asked will involve critical thinking about their practices and experiences in mathematical education, describing their strategies to enhance mathematical play and explain how they mitigate the challenges that may impede their own mathematical play practices in the ECCE setting. The role of the participants will be to participate in the semi-structured interviews and be involve in the intensive observations where I will focus on practitioners' lived mathematical play practices in early childhood care and education setting.

WHAT ARE THE POTENTIAL BENEFITS OF TAKING PART IN THIS STUDY?

Taking part of your centre in this study will bring rich and contextualized knowledge of mathematical play in various ways as participants will bring their different viewpoints/contributions to the success of the research. Practitioners will be able to understand the role that they should play in integrating play in mathematical education.

They will be able to contribute to the teaching and learning of mathematical play; and understand how to incorporate different types and stages of play and provide an opportunity for children to learn in the ECCE setting. They will be involved in the effective planning and implementation of the programmes to enrich mathematical play in the ECCE sector and I will always ensure confidentiality throughout the study. Active planning and implementation of the programmes to enrich mathematical play in the

ECCE sector and I will always ensure confidentiality throughout the study. They will be able to contribute to the teaching and learning of mathematical play; and understand how to incorporate different types and stages of play and provide an opportunity for children to learn in the ECCE setting.

WHAT ARE THE POTENTIAL RISKS TAKING PART IN THIS STUDY?

The research participants will comprise of different practitioners with different educational background, some participants may not see themselves fit for this research and as a result could not feel free to ask questions or give their inputs. Another anticipated inconvenience could be the aftercare classes where parents are collecting their children late after work. This may impact on the interview schedule for participants as interviews will take place after school when all children are left, and they may be delay in this process. If the research takes place in the multi-graded classroom, the researcher will have to wait until the teachers is working with the target children then starts to observer the practitioner's live mathematical play practices in the ECCE setting. Should we find ourselves in the COVID19 situation during the research schedule, rules and regulations of COVID19 will be followed.

WILL THE INFORMATION BE KEPT CONFIDENTIAL?

From the beginning on the consent form, I will clearly inform the participants that confidentiality, respect and privacy will be maintained throughout the study. Participants will be requested not to mention their identity in any of the study documents to avoid linking their personal responses and the participants will be assigned pseudonym and their names will be known by me only. I will use the data and photos solely for the research purpose and pseudonyms will be used for identity purposes. The information gathered from the study, including hard copies will be used securely and kept confidentially in the strong room with the encrypted password known to me only. The participants' names will not be disclosed, and the responses made will not be linked to the participant's real name so that no connection will be made to the participants' responses.

The collected data will be available to the participants on request and the Research Ethics Committee. I will also obtain the participants concern to utilise the collected data for other purposes including research presentations, educational conferences,

educational articles and further research study. In order to maintain confidentiality, a confidentiality agreement will be drawn, communicated and signed between myself and participants.

HOW WILL THE INFORMATION BE STORED AND ULTIMATELY DESTROYED?

I will keep the data in a strong room with a password known to me only. All the interview recording devices where the data is stored, hard and electronic copies will be kept securely and be accessed by myself and the university personnel for future academic purposes. The electronic data will be stored and secured by a password on a computer which will change every three months. After a certain period, the information will be permanently destroyed on hard copies and electronic devices deleted from the sources. Personnel for future academic purposes while the electronic data will be stored and secured by a password on a computer which will change every three months. After a certain period, the information will be permanently destroyed on hard copies and electronic devices deleted from the sources.

WILL THERE BE PAYMENT OR ANY INCENTIVES FOR PARTICPATING IN THIS STUDY?

There will be no payment, or any form of incentive offered to participants to take part in the study. The participants will be encouraged to participate willing in the research since its success will be beneficial to me, participants and the community at large as well. If the participants may decide to seek for more information regarding the research matter, they will be allowed to do so voluntarily, without assistance of payment or any incentive. There will be no payment, or any form of incentive offered to participants to take part in the study.

HOW WILL THE INSTITUTION / ORGANISATION / COMPANY BE INFORMED OF THE FINDINGS / RESULTS OF THE STUDY?

The final research findings of the research can be obtained on request from the me or the research promoter. Should there be any queries on the way the research proceedings were conducted, you can contact this research promoter: Professor

Chinedu Okeke, contact numbers: 051 401 2377/0730348602 or email address: OkekeCO@ufs.ac.za. Myself Seipati Baloyi-Mothibeli my contact numbers: 0845001269 or my email address SeipatiB@dut.ac.za for any information relating to this research and the research findings will be accessible for six months.

Yours sincerely

Seipati Lydia Baloyi-Mothibeli

APPENDIX E: CONSENT FORM FOR PRACTITIONERS

DATE

AUGUST 2021AUGUST 2021

TITLE OF THE RESEARCH PROJECT

PHENOMENOLOGICAL STUDY OF PRACTITIONERS' LIVED MATHEMATICAL PLAY PRACTICES IN EARLY CHILDHOOD CARE AND EDUCATION SETTING

PRINCIPLE INVESTIGATOR / RESEARCHER(S) NAME(S) AND CONTACT NUMBER(S):

Seipati Lydia Baloyi-Mothibeli Seipati 201011770 0845001269

FACULTY AND DEPARTMENT:

Faculty of Education

School of Social Sciences and Language Education

STUDYLEADER(S) NAME AND CONTACT NUMBER:

Professor Chinedu Ifedi Okeke (UFS staff member)

051 401 2377 / 0730348602

WHAT IS THE AIM / PURPOSE OF THE STUDY?

The aim of the study is to carry out a phenomenological study of practitioners' lived mathematical play practices in early childhood care and education setting.

WHO IS DOING THE RESEARCH?

My name is Seipati Lydia Baloyi-Mothibeli and a PhD student and a junior Lecturer at the Faculty of Education in the School of Social Sciences and Language Education. I hereby invite you to participate in the study. This study emanates from the fact that I

have discovered that most of practitioners are struggling to contextualize ECCE setting which mostly involve play. Practitioners are challenged when implementing and integrating play in early mathematics education in order to improve mathematics performance in higher Grades. My intention in this research is to generate evidence on what practitioners do and how they engage children in mathematical play. It is hoped that this study will of benefit to policymakers and to curriculum developers as well as practitioners in the area of ECCE. The study will assist ECCE practitioners to enhance their practices and their strategies when engaging young children in play-based mathematics.

HAS THE STUDY RECEIVED ETHICAL APPROVAL?

Yes

Approval number: UFS-HSD2020/1970/153

WHY ARE YOU INVITED TO TAKE PART IN THIS RESEARCH PROJECT?

I chose 12 (twelve) participant from 6 selected community-based centres. These will be practitioners who works directly with young children from birth to four years old. That is two participants will be identified at each centre to participate in the research. One participant will be responsible for teaching 3 (three) years old children another one will be for 4 (four) years old children. I will contact Department of Social Development and request list of the community-based centres, publicly and privately owned. The list will have a full detail that include the name of the centre and the address where each centre is located, the name of the principal or centre manager and the contact details of the centre number of practitioners employed in the centre as well as number of children and how they are grouped in their classrooms in terms of age in the classroom.

WHAT IS THE NATURE OF PARTICIPATION IN THIS STUDY?

The role of the participants will be to participate in the semi-structured interviews and be involve in the intensive observations where I will focus on practitioners' lived mathematical play practices in early childhood care and education setting. The question that will be asked will involve critical thinking about their practices and experiences in mathematical education, describing their strategies to enhance mathematical play and explain how that mitigate the challenges that might impede their own mathematical play practices in the ECCE setting. This process will take ± 3 months and while the interviews will take approximately 45 to 60 minutes per participants. I will minimise harm and risks that might hamper the full participation of the participants and ensure that they benefit optimally from participating in the study. I will ensure that none of participants will be exposed to any form of harm by not asking private and sensitive questions, thus, to preserve an atmosphere of serenity and safety throughout the sessions.

CAN THE PARTICIPANT WITHDRAW FROM THE STUDY?

I will inform the participants that their participation is voluntary and if they feel uncomfortable about responding to some of the questions during the interview, they have the right to refuse to give an answer. The researcher will make them aware that if they wish to withdraw from the research at any time, they are free to discontinue without any penalty. The researcher will first obtain the voluntary consent prior to the commencement of collecting data from participants. In addition, the researcher will read and explain the information on the consent form prior to the participants' signatures and their return of the forms.

WHAT ARE THE POTENTIAL BENEFITS OF TAKING PART IN THIS STUDY?

Taking part in this study will bring rich and contextualized knowledge of mathematical play in various ways as participants will bring their different viewpoints/contributions to the success of the research. They will be able to understand the role that they should play in integrating play in mathematical education. Practitioners will be able to understand the role that they should play in integrating play in mathematical education. They will be able to contribute the teaching and learning of mathematical play; how they can incorporate different types and stages of play, and the provisioning of

opportunities for children to learn in the ECCE setting. They will be involved in the effective planning and implementation of the programmes to enrich mathematical play in the ECCE sector and I will always ensure confidentiality throughout the study.

WHAT IS THE ANTICIPATED INCONVENIENCE OF TAKING PART IN THIS STUDY?

The research participants will comprise of different practitioners with different educational background, some participants may not see themselves fit for this research and as a result could not feel free to ask questions or give their inputs. Another anticipated inconvenience could be the aftercare classes where parents are collecting their children late after work. This may impact on the interview schedule for participants as interviews will take place after school when all children are left, and they may be delay in this process. If the research takes place in the multi-graded classroom, the researcher will have to wait until the teachers is working with the target children then starts to observer the practitioner's live mathematical play practices in the ECCE setting. Should we find ourselves in the COVID19 situation during the research schedule, rules and regulations of COVID19 will be followed.

WILL WHAT I SAY BE KEPT CONFIDENTIAL?

From the beginning on the consent form, I will clearly inform the participants that confidentiality, respect and privacy will be maintained throughout the study. Participants will be requested not to mention their identity in any of the study documents to avoid linking their personal responses and the participants will be assigned pseudonym and their names will be known by me only. I will use the data and photos solely for the research purpose and pseudonyms will be used for identity purposes. The information gathered from the study, including hard copies will be used securely and kept confidentially in the strong room with the encrypted password know to me only. The participants' names will not be disclosed, and the responses made will not be linked to the participant's real name so that no connection will be made to the participants' responses. The collected data will be available to the participants on request and the Research Ethics Committee.

I will also obtain the participants concern to utilise the collected data for other purposes including research presentations, educational conferences, educational articles and further research study. In order to maintain confidentiality, a confidentiality agreement will be drawn, communicated and signed between myself and participants.

HOW WILL THE INFORMATION BE STORED AND ULTIMATELY DESTROYED?

I will keep the data in a strong room with a password known to me only. All the interview recording devices where the data is stored, hard and electronic copies will be kept securely and be accessed by myself and the university personnel for future academic purposes while the electronic data will be stored and secured by a password on a computer which will change every three months. After a certain period, the information will be permanently destroyed on hard copies and electronic devices deleted from the sources purposes while the electronic data will be stored and secured by a password on a computer which will change every three months.

WILL I RECEIVE PAYMENT OR ANY INCENTIVES FOR PARTICPATING IN THIS STUDY?

There will be no payment, or any form of incentive offered to participants to take part in the study. The participants will be encouraged to participate willing in the research since its success will be beneficial to me, participants and the community at large as well. If the participants may decide to seek for more information regarding the research matter, they will be allowed to do so voluntarily, without assistance of payment or any incentive.

HOW WILL THE PARTICIPANT BE INFORMED OF THE FINDINGS / RESULTS OF THE STUDY?

The final research findings of the research can be obtained on request from me or the research promoter. Should there be any queries on the way the research proceedings were conducted, you can contact this research promoter: Professor Chinedu Okeke, contact numbers: 051 401 2377/0730348602 or email address: OkekeCO@ufs.ac.za. Myself Seipati Baloyi-Mothibeli my contact numbers: 0845001269 or my email address SeipatiB@dut.ac.za for any information relating to this research and the research findings will be accessible for six months.

Thank you for taking time to read this information sheet and for participating in this study. If you agree to participate in this study as this is a voluntary process, below is the consent form, your requested to read it again with understanding and ask questions of clarity if any, before you sign and return it to me

CONSENT TO PARTICIPATE IN THIS STUDY

I, _____ (participant name), 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 anonymously processed into a research report, journal publications and/or conference proceedings

I agree to the recording of the insert specific data collection method.

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

Full Name of Participant: _____

Signature of Participant: _____ Date: _____

Full Name(s) of Researcher(s): _____

Signature of Researcher: _____Date: _____

APPENDIX F: QUALITATIVE SEMI-STRUCTURED INTERVIEW GUIDE

Dear ECCE Practitioner,

My name is Seipati Lydia Baloyi-Mothibeli and a PhD student at the Faculty of Education, University of the Free State. My research is about practitioners' lived mathematical play practices in early childhood care and education (ECCE) setting in Mangaung township. I am of the view that this study will be very important for you as early childhood care and education practitioner in the community-based centres. Hence, I approached you and request your participation. I hope that the data which will be collect from observations that will take place for three to four hours in your class, as well as journal notes which will be used for capturing notes of all the important occurrences during the observation process, will be very important in this study in addressing the research question and the aim of the study. As these will be important for effective integrated play-based mathematics in the ECCE setting across the township and will also provide ununified practitioners' lived mathematical play practices in the ECCE setting. Additionally, your participation in this study, will bring rich and contextualized knowledge of mathematical play in various ways and contribute to the success of this study.

It is important for you to know and understand that your participation in this interview is voluntary and strictly confidential. If they feel uncomfortable about to respond to some of the questions, you have the right to refuse to give an answer. Your anonymity is therefore fully guaranteed such that you do not have anything to worry about as your name will not be mentioned in any of the study documents to avoid linking your personal responses to your name and you will be assigned a pseudonym. I will ensure that the time of this interview will not intrude with your official time at work and will take 60 minutes. I will also request you to tell me what time you would prefer for this interview to take place. I will be of the view that you are aware that by accepting and participating in this interview, you are granting me the freedom to use the data obtained

thereof for further research, publications and policy issues and will also obtain it on request. Thank you once more for participating in this study and your contribution will be highly valued.

SECTION 1: DEMOGRAPHIC INFORMATION

Aim: To establish who the ECCE practitioners are among others

To begin with the interview, I would appreciate if you could tell me a little bit of something about yourself and your interest in ECCE setting. Probes here may include but not limited to the participant's gender, where the practitioner was born, where the practitioner grew up, work and family, whom the practitioner lives with, etc. A checklist such as the one below will be used to capture the necessary information in this regard.

Demographic checklist

Date of interview	
Initials of Interviewer	
Assigned pseudonym	
Level of education	
Qualification	
Gender	
Place of birth rural / urban area	
Work type	
Years as ECCE practitioner	
Name of the community-based centre (pseudonym will be used)	
Location of the community-based centre	
Spoken language at home	
Spoken language at work	
Does the centre get a subsidy from the government? Y/S	

SECTION 2: THE CURRENT PRACTITIONERS' LIVED MATHEMATICAL PLAY PRACTICES IN EARLY CHILDHOOD CARE AND EDUCATION SETTING

In this section, some lead issues to be raised will include

- What kinds of practices are expected of a teacher working in the ECCE setting?
- Explain your current mathematical play practices that ensure the full participation of all children in mathematics education.
- How do these practices influence and inspire children's interest to participate fully in play-based mathematics for constructing new ideas in the ECCE setting?
- Describe how you adapt your current practice according to this approach and why?
- What is your current role in advocating appropriate practices to stimulate mathematical concepts such as purposeful play, child-directed play, scaffolding and mediation that follow children's intuition in the ECCE setting?
- Do you think when planning your mathematical play practices, you should consider developmentally appropriate play-based programmes?
- What are these developmentally appropriate play-based programmes and how do they contribute to the teaching and learning of mathematics for children?

SECTION 3: HOW ECCE PRACTITIONERS, PREPARE THE MATHEMATICAL PLAY ENVIRONMENT IN COMMUNITY-BASED CENTRES

- How do you prepare for mathematical play?
- How do you set your different teaching areas in the ECCE environment? Which teaching areas/corners do you have in your classroom and what does each entail for enhancing mathematical play?
- What do you hope to achieve at the end of each lesson and for what is the purpose of play?
- How prepared are you to enhance children's learning mathematics through play.
- Explain the teaching method you used with the children to supplement mathematical play environment in the ECCE setting.

- What is your expertise regarding your role in improving children's mathematical play?
- What type of curriculum are you using in engaging children in mathematical play?
- Have you ever be provided with the preparatory sessions as well as the hard copy of the document to be able to implement play-based learning in the ECCE setting?
- What kind of support do you receive as a practitioner to prepare you for the curriculum implementation process?
- Is there any monitoring after training? If yes, why do your think is necessary if not what might be done to support you to implant play-based mathematics?
- Where do you think you find it difficult to prepare intergraded play-based teaching and learning in ECCE setting in terms of your qualification status?
- What would you like to see happen for preparing you for effective implementation of play as a pedagogy for learning in mathematical education?
- What are your perception and beliefs for employing an intergraded lesson plan and presentation to teach mathematics in early years?
- As a practitioner how do you prepare yourself in such a way that your play-based mathematical activities consider age-appropriateness, individual child cultural background as well as the social context in terms of daily programme, teacher-guided activities, free play and child guided activities.

SECTION 4: THE CHALLENGES TO ENSURING THE PROPER MATHEMATICAL PLAY PRACTICES ENVIRONMENT

- How would you describe the challenges related to proper mathematical play practices environment? The Probes here may include challenges that are affecting both indoor and outdoor environment teaching and learning resources as well as infrastructure.
- How do these challenges affect your proper mathematical play practices in ECCE setting?
- What challenges do you think maybe facing your proper mathematical environment if there is a lack of teaching and learning resources in the indoor and outdoor environments.

- In order to ensure that there is conducive teaching and learning play-based mathematics, how will your qualifications influence this environment?
- Tell me about challenges you think that might be facing you regarding your status of qualifications that other ECCE practitioners do not experience?
- What are some challenges that might be impeding you to engage children in mathematical play and how are they impacting on the ECCE environment?
- What type of support are you expecting from Department of Social Development and Department of Education as custodians of the ECCE programme which will assist you to implement a proper mathematical play environment

SECTION 5: TO EXPLORE FACTORS THAT MAY IMPACT ON PRACTITIONERS' MATHEMATICAL PLAY PRACTICES IN THE RURAL CONTEXT

- Do you think it is important to implement mathematical education in the rural ECCE environment? If your answer is yes, state why? And if your answer is no motivate why not?
- Looking at the study, it has the element of rurality, urban as well as peri-urban area focus. I am wondering if you were teaching in either one of the scenarios, will your mathematical play practices be affected by the demographic phenomenon of location? Kindly indicate in detail how this will impact your practices in the ECCE mathematical play environment
- If you can be appointed in a rural multi-grade classroom, indicate your uniqueness in managing and teaching ECCE mathematical play in this environment. Take into consideration the number of grades and number of learners per each grade and how do you plan to ensure diverse teaching and learning in a rural setting?
- How are you going to prepare yourself for better understanding the delivery of the diverse pedagogical knowledge to ensure that no child is left behind in engaging play-based mathematics in the ECCE rural context? What kinds of learning environments will you create to ensure that there is optimal support for diverse children in a disadvantaged context?
- Are there major challenges encountered by practitioners/teachers in the rural practitioners in the ECCE context which camper to urban area ECCE setting?

- ❖ Why do you think these are challenges that may hinder your successful implantation of mathematical play in ECCE?
- ❖ How will you mitigate the above-mentioned challenges as a practitioner in that rural community to ensure quality teaching and learning in mathematics education in the early years?
- ❖ What type of support did you envisage from Department of Basic Education and Department of Social Development that will benefit effectively from Open Distance Learning and teacher development programme to improve your academic and professional development.
- ❖ Why do you think that the measures you have suggested will improve the teaching and learning of mathematical play in the rural ECCE setting?
- ❖ Tell me whether you see children growing up in the rural communities to make an excellent with regards to career development at the later stage in the word of work compared to children who grow up in urban communities. Motivate your answer.

SECTION 6: POSSIBLE MEASURES TO ENSURING THE PROPER MATHEMATICAL PLAY PRACTICES ENVIRONMENT

- What measures are in place in order to promote sustainable academic performance in the ECCE mathematics?
- As a practitioner in the ECCE setting, what kind of educational support programmes will assist you to be able to engage children in mathematical play practices.? Mention at least three and motivate why and how you will benefit from these supports educational programme.
- Tell me how pre-training, in-service training and professional support will contribute to your lived mathematical play practices in the ECCE setting?
- What measures you have put in place to ensure that you have sufficient content knowledge and pedagogical skills as a practitioner in the ECCE environment to ensure that you mediate and scaffold children's acquisition of new knowledge in mathematical education?
- Which measures are in place in your ECCE mathematical play, that ensure that you have enough indoor and outdoor teaching and learning resources to accommodate all the teaching areas for the purpose of play-based learning?

- What strategies are you using to maintain outdoor equipment? How relevant are they towards the development of the children mathematical play learning?
- Suggest 3 guidelines you will advise the parents of the children in your class to employ to enhance their children's mathematical play.
- Give a full description of how they should follow the guidelines you have provided to them and what will be the implication of following the suggested measures in mathematical education implemented at home.
- Could you suggest possible alternatives/additional strategies that you think could improve your mathematical play practices in the ECCE environment?

We have come to the end of our interview session; do you have any questions regarding this interview?

Thank your time and your cooperation

APPENDIX G: QUALITATIVE OBSERVATION GUIDE

Dear ECCE Practitioner

My name is Seipati Lydia Baloyi-Mothibeli and a PhD student at the Faculty of Education, University of the Free State. My research is about practitioners' lived mathematical play practices in early childhood care and education (ECCE) setting in Mangaung township. I am of the view that this study will be very important for your as early childhood care and education practitioner in the community-based centres in hence I approached you and request your participation. I hope that the data which will be collect from observations which will take place for the entire daily programme activities in your class, as well as journal which will be used for capturing notes on all important occurrences during the observation process. In so doing this process will be very important in this study as it will assist in addressing the research question as well as the aim of the study. Additionally, the observation assisting you as a practitioner to implement will effective integrated play-based mathematics education in the ECCE setting as well as ununified practitioners' lived mathematical play practices in the ECCE setting. Take note that your participation in this study, will bring rich and contextualized knowledge of mathematical play in various ways and contribute to the success of this study.

It is important for you to know and understand that your classroom observation in this is voluntary and strictly confidential. If they feel uncomfortable about my presence in your classroom you have the right to give me access to observe. Your anonymity is therefore fully guaranteed such that you do not have anything to worry about as your name will not mentioned in any of the study documents to avoid linking your personal responses to your name and you will be assigned a pseudonym. I will ensure that the time of this interview will not intrude with your official time at work and will take 60 minutes. I will also request you to tell me what time you would prefer for this interview to take place. I will be of the view that you are aware that by accepting and participating in this interview, you are granting me the freedom to use the data obtained thereof for further research, publications and policy issues and will also obtain it on request.

Thank once more for participating in this study and your contribution will be highly valued.

Week 1

Date of the Observation: **Name of the centre:** (pseudonyms will be used) **Number of practitioners in the centre**: **Number of Children in the centre:** **Location of the centre:**
Theme 1 ECCE contextual data which will include classroom environment, teaching and learning resources, different teaching areas and the practitioner's interaction with children.

Activities	
Focus areas	**Descriptions**
Classroom environment for the practitioner to mediate children's interactions with each other in mathematical play.	Observing the following: • Walls, floors and furniture conducive for learning and teaching mathematical play. Does the classroom allow free movement for learners and do learners have secure space for personal storage? Does the classroom provide space to group and individual mathematical play learning?
Different teaching areas involve scaffolding children for play-based mathematics.	Observing the following: • Is the classroom space big enough to accommodate different teaching areas: (mathematics area, blocks area, books areas and make-believe area?
Teaching and learning resources to enhance mathematical play.	• Observing whether there are enough teaching and learning resources and what resources are available? • Do resources have secure space for storage/ shelves and at eye-level with the children?

Week 2

Date of the Observation: **Name of the centre:** (pseudonyms will be used) **Number of practitioners in the centre:** **Number of Children in the centre:** **Location of the centre:**
Theme 2 How the practitioner mediates and scaffold children when engaging in different types and stages of play and when constructing new knowledge during the classroom interaction.

Activities	
Focus areas	**Descriptions**
Current practitioners' mathematical play practices.	Observe the current practitioners' mathematical play practices and multiple ways of learning and language employed, in the ECCE setting.
Perceptions and preparedness of practitioners' mathematical play.	Perceptions and preparedness of practitioners' mathematical play environment in community-based centres.
Challenges that may hinder the proper mathematical play practices environment.	Observe challenges that may hinder the proper mathematical play practices environment
ECCE rural context on practitioners' mathematical play practices.	Factors that may impact practitioners' mathematical play practices in the ECCE rural context
Strategies employed by practitioners in engaging children in a proper mathematical play environment.	How does the practitioner ensure the proper mathematical play practices in supporting children's environment?

WEEK: 3

Date of the Observation: **Name of the centre:** (pseudonyms will be used) **Number of practitioners in the centre:** **Number of Children in the centre:** **Location of the centre:**

Theme 3 Focuses on outdoor mathematical play activities what challenges are encountered by the participants and how they are mitigated through the zone of proximal development for the effective learning of mathematics.

Outdoor layout for mathematical play	Observing the following: • The general state of outdoor layout (playground area, outdoor play equipment, provisioning of water and sand play equipment) • The rules and discipline during outdoor mathematical play. • Is the playground conducive for provisioning of socialisation and interacting with different activities which will allow children to construct new mathematical ideas while playing? • Is there enough sand and water play equipment for children to learn measurement, mass, conservation and capacity while playing with different containers?
Outdoor play for mathematical games	Observing mathematical games that involve: • Singing a song with numbers • Throwing and catching the ball while counting. • Children roll from left to right while counting on the soft surface (green grass, outdoor artificial grass or a carpet put outdoor. • How children play a hopscotch drawn on the surface in the outdoor, counting with numbers. • Playing with different equipment such as jungle (climbing up and going down for learning descending and ascending order), old tyres painted with different colour putting together like a

	tunnel (children go through that tunnel while mentioning the colour of the tyres

WEEK 4

Date of the Observation: **Name of the centre:** (pseudonyms will be used) **Number of practitioners in the centre:** **Number of Children in the centre:** **Location of the centre:**	
Theme 4 Routine activities: toilet routine, refreshment time and tidy-up time	
Focus areas	**Descriptions**
Toilet routine and mathematical education in ECCE setting	Observing the following: • Children lining up: from1st, 2nd, 3rd (Boys and girls in 2 separate rows). • Children will be learning ordering numbers and sequencing of numbers, length as they will see which line is longer, boys or girl line. • They will also be learning good habit of taking turns
Refreshment time and mathematical play	Observing the following: • How children take turn in preparing and the tables are laid (putting plates, cups utensils and serviettes) • How is the setting arrangement during this routine (are they setting according to their symbols, age, name tags or colours) during this routine is there mathematical education taking place? • How children learn concepts of fraction through cutting different fruits, slice of bread in half, quarter and pouring juice in a litre or half a cup.

Tidy-up time and mathematical play	Observing the following: • Sorting activities, one-to-one correspondence, classifying objects according to their properties, problem-solving, developing sense of the size or the how-many-ness, more than and less than. • Knowledge and understanding of different colours and shapes of objects and their usage, manipulate objects while tidying up during mathematical play education.

Thank you for giving an opportunity to stay in your class and observe your lived mathematical play practices in the ECCE setting. You can ask any question related to this observation and if you need any clarity on any aspect you can also indicate. I will also contact you if the is any information that I might need.

Thanks once more for your participation and your cooperation

APPENDIX H: SUMMARY OF DATA FROM THE JOURNAL ENTRY GUIDE

Date:

Name of the centre: (pseudonyms will be used)

Number of practitioners in the centre:

Number of Children in the centre:

Location of the centre:

Weeks	General data emerging from semi-structured interviews	Play practices in early childhood care and education setting?	Practitioners' preparedness in teaching mathematical play in community-based centres?	Challenges to ensuring the proper mathematical play	Factors that may impact on practitioners' mathematical play practices in rural context	Measures to ensuring the proper mathematical play practices
Week 1						
Week 2						
Week 3						
Week 4						
Week 5						
Week 6						

APPENDIX I: LETTER FROM LANGUAGE EDITOR

Declaration

3 June 2022

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Dissertation: Phenomenological study of practitioners' lived mathematical play practices in an early childhood care and education setting

Student: Seipati Baloyi-Mothibeli

I confirm that I edited the dissertation, indicated which sources had to be added to the reference list, and recommended changes to the text.

MA Language Practice

APPENDIX J: TURN IT IN RECEIPT AND REPORT

Turnitin Originality Report
PHENOMENOLOGICAL STUDY OF PRACTITIONERS' LIVED MATHEMATICAL PLAY PRACTICES IN AN EARLY CHILDHOOD CARE AND EDUCATION SETTING by Seipati Baloyi-Mothibeli
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