USING AFRICANISED PLAY-BASED PEDAGOGY IN THE ONLINE TEACHING OF MENTAL MATHEMATICS TO FOUNDATION PHASE LEARNERS

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MMAKGABO ANGELINAH SELEPE

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NAME: MMAKGABO ANGELINAH SELEPE

STUDENT NUMBER: 64019209

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Signature: 

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ABSTRACT

The international curriculum in the early childhood and foundation phase encourages play-based pedagogy in teaching and learning mathematics. Furthermore, the South African curriculum stresses integrating African culture and using technologies in the foundation phase. This study explored the use of Africanised play-based pedagogy in the online teaching of mental mathematics to Foundation Phase learners. Ethnomathematics and Vygotsky's sociocultural theories underpin the study. The study employed hermeneutic phenomenology research design in qualitative research. Semi-structured interviews, document analysis and non-participant observations were used to elicit the educators' lived experiences using Africanised play-based pedagogy in the online teaching of mental mathematics to foundation-phase learners. Twelve foundation-phase educators from four public primary schools in Capricorn South District, Limpopo, participated. Three data sets were analysed using NVivo software version 14 through interpretative phenomenological analysis. The findings indicated that educators use Africanised play-based pedagogy in the online teaching of mental mathematics to develop problem-solving, mathematical thinking and counting skills. However, educators need more understanding of the use of Africanised play-based pedagogy, they have challenges of minimal African play-based activities, a limited legislative framework, and a lack of strategies for using Africanised play-based pedagogy in the online teaching of mental mathematics to foundation-phase educators. In light of these findings, guided by the theoretical framework, the literature review, and the study's findings, the study suggested strategies for educators to incorporate Africanised play-based pedagogy in the online teaching of mental mathematics to foundation-phase learners. These strategies include the use of theoretical components, lesson planning and implementation, assessments and parental involvement in the use of Africanised play-based pedagogy in the online teaching of mental mathematics in the foundation phase.

KEY TERMS: Africanised play-based pedagogy, Ethnomathematics, online teaching, mental mathematics, More Knowledgeable Other, Zone of Proximal Development, problem-solving skills

KAKARETŠO

Lenaneothuto la boditšhabatšhaba mo karolong ya bobjana le ya motheo le hlohleletša thuto yeo e theilwego go thaloko mo go ruteng le go ithuteng dipalo. Gape lenaneothuto la Afrika Borwa le gatelela go kopanya setšo sa Afrika le go šomiša ditheknolotši mo karolong ya motheo. Mo karolong ya motheo, barutiši ba sa hloka go šomiša mešongwana ye e theilwego go thaloko ba kopanya setšo le theknolotši, kudu mo go ruteng dipalo tša monagano. Kamano gare ga dipalo, setšo le diteori tša leago tša Vygotsky le Ethnomathematics (šetšo sa dipalo) di thekga nyakišišo. Nyakišišo e šomišitše mokgwa wa nyakišišo wa fenomelotši ya hemaniteki ka go nyakišišo ya boleng go utolla tšhomišo ya thuto yeo e theilwego go thaloko ya Seafrika mo go ruteng ga mmetse wa monagano ka onlaene go barutwana ba karolo ya motheo. Dipotšišo tšeo di sa latelego mokgwa wa go swana, tshekatsheko ya tokumente le ditekolo tša bao ba sa kgathego tema di šomišitšwe go hwetša maitemogelo a barutiši a thwii ba šomiša thuto yeo e theilwego go Seafrika mo go ruteng ka onlaene ga dipalo tša monagano go barutwana ba karolo ya motheo. Barutiši ba 12 ba karolo ya motheo go tšwa go dikolo tša praemari ka Seleteng sa Borwa sa Capricorn, Limpopo, ba kgathile tema. Dihlopha tše tharo tša data di sekasekilwe go šomišwa kgatišo ya 14 ya softwere ya NVivo ka go sekaseka fenomelotši ya hlathollo. Dikutollo di bontšhitšhe gore barutwana ba šomiša thuto yeo e theilwego go thaloko mo go ruteng ka onlaene go dipalo tša monagano go godiša go rarolla mathata, go nagana ka mokgwa wa dipalo le go bala mabokgoni. Gape, go hweditšwe gape gore barutiši ba hloka kwešišo ye ntši ya tšhomišo ya thuto yeo e theilwego go thaloko ya Seafrika, ba na le ditlhohlo tše dinnyane tša mešongwana ya dithaloko tšeo di theilwego go Seafrika, tlhako ya molao ye nnyane, le go hloka mekgwa ya go šomiša thuto yeo e theilwego go thaloko ya Seafrika mo go ruteng ka onlaene ga dipalo tša monagano go barutiši ba karolo ya motheo. Go lebeletšwe dikutollo tše, nyakišišo e šišintše mekgwa go barutiši go kopanya thuto yeo e theilwego go thaloko mo go ruteng ka onlaene ga dipalo tša monagano go barutiši ba karolo ya motheo. Tlhako ya teori, tshekatsheko ya dingwalwa, le dikutollo tša nyakišišo di tsebiša mekgwa ye.

MANTŠU A MOTHEO: Thuto yeo e theilwego go thaloko ya Seafrika, Kamano gare ga mmetse le setšo, go ruta ka onlaene, mmetse wa monagano, Ba Bangwe ba go Tseba Kudu, Phapano gare ga seo Morutwana a ka se Dirago ka boyena le seo ba ka

se Fihlelelago ka Tlhahlo ya Motho yo a nago le Tsebo, mabokgoni a go rarolla mathata.

MANWELEDZO

Kha kharikhuḽamu ya dzitshaka kha vhuhana thangeli na vhuimo ha fhasi hu ṱuṱuwedzwa pfunzo yo ḓisendekaho nga u tamba kha u funza na u guda mbalo. zwiṅwe hafhu, kharikhuḽamu ya Afrika Tshipembe I khwaṱhisedza mvelele ya Afrika na u shumisa thekhinoḽodzhi kha vhuimo ha fhasi. Kha vhuimo ha fhasi vhadededzi vha kha ḓi ṱoḓa thuso ya u shumisa nyito dzo ḓisendekaho nga u tamba dzi elanaho na mvelele na thekhinoḽodzhi nga maanḓa kha u funza mbalo dza murekanyo. Mbalo dza ethno na thyeori dza mvelele na matshilisano dza Vygotsky ndi mutheo wa ngudo. Ngudo dzo shumisa nyolo ya ṱhoḓiso ya tshibveleli ya hemeneuthiki nga ngomu ha ṱhoḓisiso dza khwaḽithethivi u itela u sedzulusa pfunzo yo ḓisendekaho nga u tamba ya Afrika kha u funza ha kha lubuvhisia ha mbalo dza murekanyo kha vhagudi vha vhuimo ha fhasi. Inthaviwu dzo dzudzanywaho zwiṱuku, musaukanyo wa maṅwalwa na mbono dza u sa dzhenelela zwo shumiswa u wana tshenzhelo vhukuma dza vhadededzi nga u shumisa pfunzo yo ḓisendekaho nga u tamba ya Afrika kha u funza nga kha lubuvhisia ha mbalo dza murekanyo kha vhagudi vha vhuimo ha fhasi. Vhadededzi vha vhuimo ha fhasi vha fumimbili u bva kha zwikolo zwa phuraimari zwa nnyi na nnyi kha Tshiṱiriki tsha Capricorn South, Limpopo, vho dzhenela. Sethe dza data tharu dzo lavhelelwaho dzo saukanywa nga u shumisa NVivo software vesheni ya 14 nga kha musaukanyo wa tshibveleli. Mawanwa o sumbedza uri vhadededzi vho shumisa pfunzo yo ḓisendekaho nga u tamba ya Afrika kha u funza mbalo dza murekanyo kha lubuvhisia na u bveledza u tandulula thaidzo, kuhumbulele kwa mbalo na zwikili zwa u vhalela. Zwiṅwe hafhu, zwo wanala uri vhadededzi vha ṱoḓa u pfesesa vhukuma kha kushumiselwe kwa pfunzo yo ḓisendekaho nga u tamba ya Afrika, vha na khaedu dza nyito dzi si gathi dza nga u tamba ho ḓisendekaho nga zwa Afrika, muhanga wa kushumele wa theo ya mulayo wo fhimiwaho, na u shaya zwiṱirathedzhi zwa u shumisa pfunzo yo ḓisendekaho nga zwa Afrika kha u funza kha lubuvhisia ha mbalo dza murekanyo kha vhadededzi vhuimo ha fhasi. Ho sedzwa mawanwa aya, ngudo dzo dzinginya zwiṱirathedzhi zwine vhadededzi vha nga zwi dzhenisa zwa pfunzo yo ḓisendekaho nga u tamba ya Afrika kha mbalo dza murekanyo dza kha lubuvhisia u itela vhadededzi vha vhuimo ha fhasi. Muhanga wa kushumele ya thyeori, tsedzuluso dza maṅwalwa na mawanwa a ngudo dzo tikedza zwiṱirathedzhi izwi.

MATHEMO A NDEME: Pfunzo yo ḓisendekaho nga u tamba ya Afrika, mbalo dza ethno, u funza ha kha lubuvhisia, mbalo dza murekanyo, Muṅwe a re na Nḓivho Nnzhi, Fhethu ha Mveledziso ya Gumofulu, zwikili zwa u tandulula thaidzo

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LIST OF ACRONYMS

ATP	Annual Teaching Plan
CAPS	Curriculum Assessment and Policy Statement
COVID-19	Corona Virus Disease of 2019
CSCL	Computer-Supported Collaborative Learning
DBE	Department of Basic Education
ECD	Early Childhood Development
ECCE	Early Childhood Care Education
ECE	Early Childhood Education
EYFS	England's Early Years Foundation Stage
FP	Foundation Phase
ICT	Information and Communications Technology
IPA	Interpretative Phenomenological Analysis
LPDE	Limpopo Provincial Department of Education
MKO	More Knowledgeable Other
NECT	National Education and Collaboration Trust
NGO	Non-Government Organisation
NRF	National Research Framework
SBA	School-Based Assessment
STEM	Science, Technology, Engineering and Mathematics
UNICEF	United Nations of Children's Fund
UNISA	University of South Africa
YDE	Yukon Department of Education
YFNED	Yukon First Nation Education Directorate
ZPD	Zone of Proximal Development

CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION AND BACKGROUND OF THE STUDY

Competence in Science, Technology, Engineering and Mathematics (STEM) subjects is urgently required in modern economies. Teaching and learning mathematics is a matter of significant concern in South Africa where learner performance is so dire that new creative ways of teaching and learning have had to be devised. Mosimege and Winner (2021) state that South African learners perform poorly in mathematics. Chand et al. (2021) indicate that poor mathematics performance in primary and secondary schools affects competence in this subject at higher education institutions. This could mean that the foundation for developing problem-solving skills needs to be more solid in the early grades. Pongsakdi et al. (2020) indicated that one of the contributing factors to poor achievement in mathematics is a lack of problem-solving skills.

Early Childhood Education (ECE) has a role to play as a crucial first step in the academic development of learners. Historically, ECE has focused on social interaction as a critical method of enhancing young children's cognitive, physiological, and social development (Issacs et al., 2019). According to the Department of Social Development (2015), before 1996, ECE focused solely on social interaction. Since that time, much has been done in the field of ECE in South Africa to improve the quality of early learning programmes. After 2015, with greater emphasis on teaching ECE, play-based pedagogy was included in the curriculum. The Department of Basic Education (DBE) (2001), the Department of Justice (2005), and the Department of Welfare (1997) all emphasised the need to use play-based pedagogies in increasing social interaction among children.

The DBE support for play-based pedagogies is anchored in an evidence-based policy-making process informed by scientific research. Using a play-based strategy is also advised by the Curriculum Assessment Policy Statements (CAPS) (DBE, 2011), which provides educators with an adequate framework and guidance in the Foundation Phase (Grades R to 3), especially in teaching mathematics. In this regard, numerous scholars such as Lunga et al. (2022), Mofokeng and Mukuna (2023), and Mohammed et al. (2023) found that play-based pedagogy has a significant role in holistic development, such as cognitive, emotional, language, physical and social interaction

skills. Similarly, Mofokeng and Mukuna (2023) indicated that using play helps to improve social, verbal and cognitive skills. Furthermore, Mohammed et al. (2023) agree that play-based learning can assist children in developing emergent literacy, numeracy and socio-emotional skills. Based on its apparent benefits, play-based pedagogy is used within an extended historical and rich cultural context of South Africa.

The literature has emphasised the holistic development of young learners in early childhood development (ECD) concerning mathematics. However, this has always been done in traditional classrooms where the educator and the learners are in the same space. Since the COVID-19 pandemic, online learning has become a more pressing need. This study thus explores the use of Africanised play-based pedagogy in online teaching of mental mathematics to foundation-phase learners. In light of this, by understanding how to use this phenomenon in the online teaching of mental mathematics to foundation phase learners could address the challenge of underperformance in mathematics.

This relates to the concept of ethnomathematics, which is “a field of mathematical ideas and activities that are embedded in the cultural contexts of societies” (Ergene & Ergene, 2020, p.402). Ethnomathematics provides the concrete contexts for the younger learners in learning of mathematics and “helps to improve learners’ ability to establish meaningful connections and deepen their understanding of the subject by connecting mathematical concepts to their cultural contexts” (Jacob & Dike, 2023, p.380).

In education, practitioners and researchers have called for the Africanisation of the curriculum, including in the Foundation Phase (FP) (Grades R–3). The term “Africanisation” or “Africanised” is used to describe concepts and behaviours whose roots may be found in African traditions of knowledge, teaching, and learning (Knaus et al., 2022). Africanisation in the classroom aims to conscientise young learners’ minds by increasing their awareness of African culture and motivating them to exercise their critical thinking and problem-solving skills within an African context.

Indigenous knowledge refers to cultural understandings, skills and philosophies due to Africanisation and decolonisation (Mutongoza et al., 2023). Shoko and Naidu (2022)

showed that Africanisation and decolonisation are centred on indigenous knowledge. Owusu and Obuo Addo (2023) posit a need to incorporate cultural play-based activities in mathematics classrooms to teach mathematics to young learners. In light of this, the researcher argues that using Africanised play-based pedagogy could contribute to the Africanising of the mathematics curriculum, especially in the FP.

1.2 RATIONALE OF THE STUDY

The CAPS document supports using Africanised play-based pedagogy in teaching mathematics in the FP. Mathematics teaching in the FP includes valuing and acknowledging culture, indigenous knowledge and rich history (DBE, 2011). According to Kroeze (2019), the curriculum supports using Africanised play-based pedagogy because it enhances learners' mathematical and scientific skills. To support this, Govender and Mudzamiri (2021) agree that incorporating African games in mathematics helps learners understand mathematical concepts. However, previous research by Hwa (2018) indicates that using digital play-based pedagogy is more effective than African play-based learning in teaching mathematics to young learners. In light of this statement, the researcher examines how Africanised play-based pedagogy can be used in the online teaching of mental mathematics to develop learners' mathematical and scientific skills and understand mathematical concepts.

There have been attempts to use Africanised play-based pedagogy in teaching mathematics in South Africa (Lunga et al., 2022). To date, there needs to be more focus on using Africanised play-based pedagogy in teaching mathematics in the FP. This is an area that the CAPS curriculum policy needs to address. Besides its integration into online teaching, Africanised play-based pedagogy initiatives by education policies to foundation-phase educators in their mathematics classes still need to be made (Van As & Excell, 2018). Thus, this study focuses on how FP educators who teach mathematics can use Africanised play-based pedagogy in the online teaching and learning of mental mathematics. DBE (2011) states that mental mathematics strongly features in the content area of numbers, operation and relationships, which weighs 65% in Grade 1, 60% in Grade 2, and 58% in Grade 3. The weighting helps adequately guide the time needed for teaching and assessment activities in this content area. Against this background, the researcher saw the need

to use Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners.

This study emerged from the researcher's master's study, which explored the role of play in teaching number sense to Grade 3 learners. It was found that educators are using indigenous play-based activities to develop social interaction among learners, which assists in enhancing number sense skills. The researcher believes teaching FP learners mental mathematics online is best accomplished through Africanised play-based pedagogy. As such, this research links with broad categories under education, humanities and social sciences with national research framework (NRF) and digital transformation within national categories. Young learners' holistic development can be assisted by drawing from African knowledge, which will allow them to acquire problem-solving skills essential for mathematics success. The problem statement is discussed in the section that follows to assist in shaping the study's scope.

1.3 PROBLEM STATEMENT

Play-based pedagogy is one of the active learning approaches employed in teaching foundation-phase mathematics. It is evident from the literature that play-based mathematics activities provide opportunities for learners to learn fundamental math concepts naturally and entertainingly and support the areas of development. However, in most cases, play-based pedagogy is implemented in a face-to-face mode of teaching and learning, especially when African games are involved. DBE (2011) encourages educators to integrate online teaching of mathematics. Still, there is a gap on understanding how to use Africanised play pedagogy into online teaching platforms. While previous studies such as Hwa (2018) and Van As & Excell (2018) have generally explored general mathematics in the online teaching, this study is different as it focuses on mental mathematics in the foundation phase.

During the observations of the researcher's master's study, the researcher witnessed the integration of African games in play-based pedagogy and identified a gap in using the same play-based activities in an online teaching and learning environment. Since COVID-19 necessitated a paradigm shift toward online teaching and learning, this study aims to explore the use of Africanised play-based pedagogy in the online teaching and learning of mental mathematics to FP learners.

Without this study, foundation phase educators may continue to struggle with implementing effective teaching strategies in using Africanised play-pedagogies in the online teaching of mental mathematics to foundation phase learners, leading to poor mathematics achievement and poor quality of education.

1.3.1 Research Questions

The main question guiding this study is:

- How can Africanised play-based pedagogy be used in the online teaching of mental mathematics to foundation-phase learners?

The research sub-questions related to the main question are:

- What role does Africanised play-based pedagogy play in the online teaching of mental mathematics to foundation-phase learners?
- What are suitable African play-based activities in the online teaching of mental mathematics to foundation-phase learners?
- What legislative frameworks guide teachers using Africanised play-based pedagogy in the foundation phase?
- What strategies do educators use to support learners using Africanised play-based pedagogy in teaching mental mathematics to foundation-phase learners?

1.3.2 Aim and Objectives of the Study

This study explored the use of Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. The following general objectives were addressed and assisted in realising these objectives:

- To understand the role of Africanised play-based in the online teaching of mental mathematics to foundation-phase learners.
- To identify suitable Africanised play-based activities for the online teaching of mental mathematics to foundation-phase learners.
- To identify and understand the legislative frameworks guiding the use of Africanised play-based pedagogy in the foundation phase of teaching.

- To investigate support strategies that educators can use during Africanised play-based pedagogy in teaching mental mathematics to foundation-phase learners online.

1.4 THEORETICAL FRAMEWORK

The theoretical framework is the structure that holds or supports the theory of a research study (Varpio et al., 2019). Kivunja and Kuyini (2017) discussed that it predicts and shapes the direction of the study based on the topic, research questions and selected variables. Nilsen et al. (2020) specified that a theoretical framework introduces and describes the theory/theories that explain why the research problem under study exists. It is a foundation for the analysis, especially in education research. The theoretical framework serves as a guide throughout the study. The researcher used a theoretical framework as a guide for data analysis strategies.

Furthermore, it aims to make research findings more meaningful and acceptable Deterding and Waters (2021) and ensures generalizability (Yarkoni, 2022). It enhances the empiricism and rigour of research (Mensah, Agyemang, Acquah, Babah, & Dontoh, 2020). This study employed ethnomathematics and Vygotsky's sociocultural theory to provide a particular perspective or lens when exploring the use of Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners and techniques to resolve it. This section is divided into two parts; the first part discusses each theory's distinctive meanings, while the second part shows the importance of integrating these two theories to shape the direction of Africanised play-based pedagogy in the online teaching of mental mathematics. Chapter 2 provides a thorough explanation of this.

1.4.1 Ethnomathematics

This theory argues for the integration of African culture in the teaching and learning of mathematics. The principles of ethnomathematics require mathematics educators to have a thorough knowledge of African culture and how it can be used to develop learner's problem-solving skills and mathematical thinking. This is validated by Spangenberg (2021) and Rosa and Orey (2019), who stated that applying this theory in mathematics classrooms involves lessons from indigenous, cultural and Africanisation perspectives.

By understanding ethnomathematics and its application, educators can realise the principle of valuing indigenous knowledge as stated in the CAPS curriculum (DBE, 2011). However, there needs to be guidelines or strategies for applying this theory's principles to develop young learners' problem-solving and mathematical thinking skills. It can be argued that learners can better understand mathematical concepts and ideas when connected to a play-based pedagogy context and practical circumstances. Nur et al. (2020) concur that contextual learning with ethnomathematics fosters problem-solving abilities based on the thinking levels of learners. In other cultures, Japanese traditional games have the potential to be an alternative media for improving children's problem-solving skills (Iswinarti & Suminar, 2019). Informed of this, the researcher discussed themes such as the six dimensions of ethnomathematics, the role of cultural activities in teaching and learning mathematics, and the integration of Africanised play-based pedagogy in teaching and learning mathematics in Chapter 2. The following section discusses the importance of Vygotsky's sociocultural theory in teaching mathematics in the FP.

1.4.2 Vygotsky's Sociocultural Theory

Vygotsky's sociocultural theory assumes that when learners engage in play-based activities incorporating culture, they develop social interaction skills. Furthermore, it was emphasised that educators must use online teaching to establish learners' problem-solving skills. Ameri (2020) confirmed that young learners develop mental functions by engaging in activities that infuse culture and focus on cultural aspects. In the same view, Vygotsky's sociocultural theory emphasises the significance of social interaction and culture in enhancing learners' mental and problem-skills.

Vygotsky further emphasised the significance of the Zone of Proximal Development (ZPD) and the role of More Knowledgeable Others (MKOs) in developing young learners' holistic development. Scholars such as Loizou and Loizou (2022) asserted that educators and parents can apply the ZPD concept to foster social interaction between children. Therefore, using play-based activities that integrate culture could assist in moving children's level of knowledge to the next level. They also mentioned that these activities increase their mental and problem-solving skills (Twumasi & Afful, 2022).

Kusmaryono, Jupriyanto, and Kusumaningsih (2021), Li (2022), and Twumasi and Afful (2022) believed that educators as MKOs are responsible for assisting learners to develop mental and problem-solving skills through the use of play-based pedagogy. Kusmaryono et al. (2021) affirmed that learners can solve mathematical equations as they play. Likewise, Li (2022) agreed that learners' mathematical knowledge could be improved using play-based activities that require mental skills applications. In addition, Twumasi and Afful (2022) concurred that both the ZPD and MKO play a fundamental role in developing learners' mathematical thinking and problem-solving skills. Recently, Ling and Mahmud (2023) have argued that online teaching can be used to develop learners' problem-solving skills. As such, the researcher believes that educators (MKO) can apply the ZPD concept through play pedagogies that integrate culture and online teaching to develop learners' problem-solving skills and mathematical thinking.

1.4.3 The Importance of Linking Ethnomathematics and Vygotsky's Sociocultural Theory that Serves as a Lens for This Study

Ethnomathematics and Vygotsky's sociocultural theories were chosen because they complement each other in this study. Ethnomathematics theory outlines the importance of culture in teaching mathematics as it develops learners' problem-solving skills. Vygotsky's sociocultural theory motivates the use of play-based pedagogy with culture and social interaction through the application of the ZPD by MKOs. Vygotsky further promotes integrating online teaching to develop young learners' problem-solving skills. Therefore, the frame of this study is problem-solving skills. It requires learners to solve mathematical problems with an appreciation of culture, identity and indigenous knowledge.

As such, the theoretical framework guided the study based on the selected topic, research problem, research questions, selected variables, appropriate methodology and data analysis techniques to enhance the empiricism and rigour of this research. As a result, it assisted the researcher in discussing findings, drawing conclusions and recommendations, and formulating suggested strategies that could help educators use Africanised play-based pedagogy in online teaching mental mathematics to FP learners.

1.5 PRELIMINARY LITERATURE REVIEW

A literature review helps researchers identify inconsistencies, research gaps, conflicts in previous studies related to the topic of the study, and open questions left by other scholars. Peters, Marnie, Tricco, Pollock, Munn, Alexander, Mclnerney, Godfrey and Khalil (2020) explained that a literature review aims to identify studies related to this study and find knowledge gaps in the evidence presented. Snyder (2019) affirmed that a literature review is used to motivate the aim and justify the research questions and objectives of the study. It is against this background that a literature review in this study helped the researcher to identify knowledge gaps or inconsistencies from empirical studies related to Africanising play-based pedagogy in the online teaching of mental mathematics to FP learners.

Sarhan and Manu (2021) mentioned four types of literature review: traditional or narrative, systematic, meta-analysis and meta-synthesis. According to Sarhan and Manu (2021), a conventional/narrative literature evaluation helps identify gaps or inconsistencies that help identify themes related to research questions and shape theoretical and conceptual frameworks. A systematic literature review addresses highly structured and specific research questions (Stamatios, 2024). Knight, Patterson and Dawson (2019) stated that meta-analysis literature focuses on analysing and drawing conclusions using standardised statistical procedures. Lastly, the meta-synthesis literature review builds on prior conceptualisations and interpretations using non-statistical methods from qualitative studies(Knight et al., 2019). To review the relevant literature for this study, the researcher employed a traditional literature review by Sarhan and Manu (2021), using five themes that respond to the research questions. The literature review is presented in detail in Chapter 3. The themes were:

- Africanised play-based pedagogy in the online teaching of mental mathematics.
- The role of Africanised play-based pedagogy in the online teaching of mental mathematics.
- Types of African play-based activities suitable for online teaching of mental mathematics to FP learners.
- Legislative frameworks guide the use of Africanised play-based pedagogy in the FP.

- Strategies used by teachers to support foundation-phase learners when using play-based pedagogy for mental mathematics teaching.

1.5.1 Africanised Play-Based Pedagogy in the Online Teaching of Mental Mathematics

The researcher reviewed the literature on Africanised play-based pedagogy in the online teaching of mental mathematics globally. As a result, literature was sourced from international and national empirical studies. Countries with similar ECE systems use play-based pedagogy and online teaching of mental mathematics.

1.5.2 The Role of Africanised Play-based Pedagogy in the Online Teaching of Mental Mathematics.

The studies have indicated that using African culture in teaching mathematics online increases learners' problem-solving and mathematical thinking skills. Evidence from Moloi, Mosia, Matabane and Sibaya (2021) shows that incorporating an African game called skipping rope in teaching mathematics improves learners' creativity, imagination and problem-solving skills. Javanese traditional games like Bekelan, Congklak lidi, and Selentikan have the potential to be an alternative medium for improving children's mathematical problem-solving skills (Swinarti & Seminar, 2019).

1.5.3 Suitable African Play-Based Activities in the Online Teaching of Mental Mathematics

There needs to be more literature on Africanised games in the online teaching of mental mathematics. As such, the researcher reviewed the literature on African games that can be incorporated into online mathematics teaching. The researcher showed how educators could use games such as Morabaraba, Ludo and Math Zap Cards to enhance learners' problem-solving and mathematical thinking skills in teaching mathematics (Tangkur, Nabie & Ali, 2022).

1.5.4 Legislative Frameworks Guiding the Use of Africanised Play-based Pedagogy in the Foundation Phase of Teaching

Play-based pedagogy legislative frameworks are crucial because they may unequivocally confirm children's right to play throughout the FP period of education. The most explicit affirmation of the significance of legislative frameworks comes from

Modise (2021), who stated that these frameworks guide educators in adhering to and implementing play-based pedagogy to improve the quality of teaching and learning. The researcher reviewed legislative frameworks that guide educators in using Africanised play-based pedagogy in the FP of teaching internationally and nationally. However, there still needs to be a gap in the infusion of African culture in the online teaching of mental mathematics to foundation-phase learners.

1.5.5 Strategies used by Teachers to Support Foundation-Phase Learners when Using Play-Based Pedagogy for Mental Mathematics Teaching

One of the strategies established by the DBE is Bala Wande, which was developed in collaboration with Funda Wande (Meiring, 2021). This strategy strives to assist learners in counting and understanding in the FP. Bala Wande uses different play-based activities and provides educators with materials such as learners' workbooks and guides. Conversely, this strategy emphasises do not incorporate culture and cannot be used in online teaching. The enhancement of problem-solving skills, inclusion of assessments, developmentally appropriate practice and collaboration between stakeholders and teachers were discussed.

1.6 RESEARCH METHODOLOGY

A research methodology in education is a systematic way of solving educational issues (Sutiani, 2021). Pandey and Pandey (2021) agreed that it is a systematic, formal and intensive process of carrying on the scientific analysis method. For this study, research methodology in education helps to employ relevant methods to solve educational problems by answering formulated research questions guided by the problem statement. The research methodology employed in this study is thoroughly explained in Chapter 4. In this instance, the research methods assisted in exploring the use of Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners.

1.6.1 Research Paradigm

The word paradigm originated from the Greek word "*paradeigma,*" meaning pattern (Antaki, 2020). According to Kivunja and Kuyini (2017), a research paradigm is a lens through which a researcher looks at the world. Pilarska (2021) verified that it constitutes the abstract beliefs and principles that shape how a researcher sees the

world, interprets it and acts within it. The research paradigm in this study refers to a pattern that influences the researcher to a worldview concerning what has been studied. Research paradigms are positivist/post-positivist, pragmatic, interpretivism/constructivist, transformative or indigenous/indigenous-oriented (Kivunja & Kuyini, 2017; Romm, 2018).

Each paradigm can be categorised by its methodology, ontology and epistemology and a comprehensive explanation of this is provided in Chapter 4. First, positivist researchers believe in only one reality that can be measured and understood (Park, Konge & Artino, 2020). In contrast, Ang, Lee and Lie (2020) mentioned that pragmatist researchers think that reality is constantly understood and renegotiated in light of fresh and unforeseen circumstances. Second, Varpio, O'Brien, Rees, Monrouxe, Ajjawi and Paradis (2021) revealed that interpretivist researchers interpret their world and believe in multiple truths and subjectivity. Third, the transformative paradigm is concerned with changing the dominant structures that perpetuate the oppression of people by gender, race, culture, class, sexual orientation and ethnicity. Last, the indigenous-oriented paradigm brings historically neglected traditional and local knowledge of the native people of the Southern Hemisphere (Romm, 2018).

The interpretive research paradigm was selected as it is relevant for this study. Just like other interpretive researchers, the researcher interpreted the views and experiences of participants to explore the use of Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners that are influenced by their culture, history and social perspectives. How this paradigm was used in this study is explained in more detail in Section 4.2. The following section describes the research type and approach based on the selected paradigm.

1.6.2 Research Type and Approach

The previous section explained the selection of the interpretive research paradigm. Two (2) research types classified according to their objectives employ the theoretical and applied approaches. Theoretical research generates information without consideration of its potential applications. Green and Thorogood (2018) described applied research as drawing on particular theory/theories to develop strategies that can be used to address a specific research problem that generates practical scientific knowledge. Based on this study's research objective, which is 'to investigate support

strategies that educators can use during Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners,' the researcher used applied research to achieve this, thus producing practical scientific knowledge to address the research problem.

The term 'research approach' refers to a plan and procedure consisting of broad assumptions and specific data collection, analysis and interpretation (Dawadi, Shrestha & Giri, 2021). Al-Ababneh (2020) and Kankam (2019) affirmed that the selection of research approach is influenced by the nature of the research problem and paradigm to collect, analyse and interpret data scientifically. For this study, the research approach is a plan and procedure that the researcher selects based on the problem statement and chosen paradigm that helps with data collection, analysis and interpretation.

Three (3) main research approaches are outlined, namely quantitative, qualitative, and mixed methods (Grønmo, 2019). O'Connor and Joffe (2020) stated that quantitative research analyses the relationship between variables that can be measured using statistical procedures and is associated with the positivist paradigm. The qualitative approach explores and understands the views and experiences of different individuals to construct multiple realities, which is usually linked with the interpretivist paradigm. The mixed-method approach integrates quantitative and qualitative data by gathering both types of information. As a result, it uses a pragmatic paradigm (Hitchcock & Onwuegbuzie, 2020). The interpretivism research paradigm assists in employing a qualitative research approach to gather in-depth, rich and detailed data from social settings. This approach helped to determine the relevant research design, data collection methods, data analysis strategy and interpretation of results. The qualitative research approach guides selecting the research design in the next section.

1.6.3 Research Design

The previous section described this study's qualitative research approach to choose the appropriate research design. The research design is a technique in which a researcher integrates the study's different components coherently and logically to ensure the research problem is addressed (Ridzuan, Ridzuan & Ridzuan, 2021). Dawadi et al. (2021)added that it serves as a structure to answer the research questions. Pandey and Pandey (2021) highlighted that it constitutes the blueprint of

various research methods, including selecting data collection tools, data analysis strategy and interpretation of findings. Similarly, the research design in this study refers to an approach whereby a researcher selects relevant methods to answer the research questions and address the problem of the study.

Various qualitative research designs have been proposed, including historical studies, phenomenology, grounded theory, ethnography, and case studies (Tomaszewski, Zarestky & González, 2020). The role of the researcher in a historical analysis is to infer implications for the present and future from previous research that may result in a biography (Rashid, Rashid, Warraich, Sabir & Waseem, 2019). In phenomenology, the researcher explores data that clarifies how participants experience a phenomenon and later identifies themes related to that phenomenon (Larkin, Shaw & Flowers, 2019). Using grounded theory, the researcher seeks to create a theory concerning a social issue (Thornberg & Dunne, 2019). Researchers aim at understanding group culture through ethnography (Tomaszewski et al., 2020). A case study is chosen when a researcher intends to understand the in-depth experiences of one person, family, group, or community (Schoch, 2020). In the context of this research, it was suitable to select phenomenological research to understand the experiences of educators related to this study.

Suddick, Cross, Vuoskoski, Galvin and Stew (2020) discussed three (3) pillars of phenomenology research: transcendental, hermeneutic and existential. Suddick et al. (2020) explained that transcendental phenomenology emphasises the significance of intentionality in obtaining conscious experience, while hermeneutical phenomenology interprets human lived experiences in a historical or social context (Dangal & Joshi, 2020). Lastly, existential phenomenology is used by researchers to focus on participants' perceptions, which centre on transience, spatiality, subjectivity, intersubjectivity, language and sexuality(Kirschner, 2022). In this study, hermeneutic phenomenology was used to explore participants' lived experiences using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. As such, the researcher analysed and interpreted the views and experiences of educators to understand their meanings. The following section discusses population and sampling.

1.6.4 Population and Sampling

It should be noted that there is a semiotic relationship between population and sampling, which is about understanding how we use a subset of data to gain insights into the characteristics of a larger group and being aware of the nuances and limitations inherent in this process.

1.6.4.1 Population

A research population comprises all the objects or events of a particular kind that researchers seek knowledge or information about (Pandey & Pandey, 2021). Sileyew (2019) posited that a study population is the group from which the actual sample is drawn. In addition, Lesko, Fox and Edwards (2022) indicated that a population is a group of individuals from which a researcher aims to gather data. In light of this, a research population is a group of participants in which the researcher selects a sample to collect primary data related to the study. The total population of this study is public primary school educators, estimated at 300, who are involved in using Africanised play-based pedagogy. More details on the population are provided in Section 4.6.1.

1.6.4.2 Sampling

Sampling is a technique of choosing participants from the population to draw statistical conclusions and estimate similar characteristics (Pandey & Pandey, 2021). Taylor, Landry, Paluszek, Fergus, McKay and Asmundson (2020) discovered that it is a selection of participants based on specific criteria to generate data out of a larger population. A researcher employs a specific sampling technique to select a sample from a population (Mishra & Alok, 2017). For this study, sampling is a strategy that a researcher uses to select participants centred on specific criteria to gather in-depth data. Qualitative researchers commonly use non-probability methods instead of probability sampling techniques (Mishra & Alok, 2017).

Non-probability sampling methods include purposive, snowball, quota and convenience samples. Table 1.1 shows the descriptions of each sampling technique in qualitative research:

Table 1.1: Description of different qualitative sampling techniques

Sample technique	Description
Purposive	The researcher looks for participants with similar qualities.
Snowball	To find new participants, researchers rely on participant referrals.
Quota	Researchers choose cases from among several categories.
Convenience	Researchers collect data from convenient cases.

(Adapted from Mishra and Alok, 2017)

As advised by Kalu (2019), the researcher used purposive sampling to recruit educators who can provide in-depth and detailed information about using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. The researcher sampled educators who could and were willing to provide data on knowledge and experience of teaching mathematics in the FP. The researcher aimed to explore their views and experiences on using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners.

Within purposive sampling, the researcher used homogenous purposive sampling where participants share the same occupation as FP educators (Prati, 2021). As a result, the selection of three (3) educators from four (4) different primary schools in Capricorn South District, Limpopo Province, was based on characteristics like having at least three years of teaching experience, teaching mathematics in the FP and being of African ethnicity. Educators who did not meet the inclusion criteria were excluded. A total sample of twelve (12) FP educators were sampled with inclusion and exclusion criteria specified in Section 4.6.2. The researcher's interest was to explore using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners.

1.6.5 Data Collection Methods

The selection of appropriate data collection instruments was fundamental to answering the study's research questions. On the one hand, Dawadi et al. (2021) explained that choosing appropriate qualitative research instruments aids in assessing the reliability of findings while using multiple methods increases the credibility of results. For this

study, qualitative tools played a role in collecting in-depth data that might uncover participants' views and lived experiences of the phenomenon.

On the other hand, the qualitative data collection method plays a vital role in gathering in-depth information that might disclose participants' emotions, perspectives, perceptions and experiences, which is essential for exploring any phenomena in a social context (Busetto, Wick & Gumbinger, 2020). Groenland and Dana (2019) put forward a similar role: qualitative research tools shed light on the phenomenon and help the participants understand the underlying views and motivations. Because this study used a hermeneutical phenomenology research design, it was essential to select research instruments such as interviews, questionnaires, focus groups, observation, documents, and records (Natow, 2020).

1.6.5.1 Interviews

An interview is a data collection method using question-and-answer sessions to gather participant data (Allan, 2020; Egger, Lei & Wassler, 2020; Ganesha & Aithal, 2022). Structured, semi-structured, unstructured and focus group interviews are among the various forms frequently distinguished by their degree of structure (Gill & Baillie, 2018). Structured interviews are commonly used when asking closed-ended questions in qualitative or quantitative research. Open-ended questions that delve into probing questions are permitted in semi-structured discussions. Unstructured interviews need a fixed format or a pre-planned set of questions. Focus group interviews differ from semi-structured interviews in that questions are delivered to a group as a whole rather than just one participant.

Guided by Gill and Baillie (2018) and Egger et al. (2020), the researcher used semi-structured interviews to solicit the views and experiences of educators on the use of Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. This resulted in prolonged engagement, where the researcher asked questions individually, depending on how educators answered questions from the interview schedule. All twelve participants were involved in interview conversations. An audio recorder was used to capture the researcher's and the participants' conversations because it increases internal validity in qualitative research. The use of semi-structured interviews in this study is discussed in Section 4.7.1.

1.6.5.2 Document analysis

Chandra and Shang (2019) and Tomaskova and Tirkolaee (2021) defined document analysis as a systematic procedure for reviewing and analysing printed and electronic documentary evidence to answer specific research questions. Akinyode and Khan (2018) highlighted that document analysis calls for examining and interpreting data to produce meaning, comprehending and generating empirical knowledge in qualitative research.

Prasad (2019) explained that what is required for a document analysis depends on the researcher's epistemological or ontological approaches, which may include or may not be anchored in content analysis, semiotics, discourse analysis, interpretive analysis, conversation analysis or grounded theory. Guided by Akinyode and Khan (2018) and Varpio et al. (2021), the researcher used interpretivist analysis to interpret documents requested from educators to answer the research questions of this study. Price, Domoney, Ariss, Hughes and Trevillion (2021) present three primary types of documents: records, personal documents and physical evidence. Public records are the official, ongoing records of an organisation's activities. In contrast, individual documents are the first-person descriptions of a person's actions, experiences and views and physical evidence is real-world items found while conducting the study. The researcher requested educators' copies of the lesson plan and learners' activity books. The researcher interpreted lesson plans and activity books guided by a document analysis tool. The analysed copies of documents were used to corroborate educators' responses from semi-structured interviews to see how they planned their lessons and the contributions of lessons towards learners' achievement in number sense class activities. This is expanded on in Section 4.7.2.

1.6.5.3 Observations

Observation is a way of collecting data through watching, listening, reading, touching, and recording behaviour and characteristics of phenomena (Dyar, 2022; Marietto, 2018; Whitehead & Whitehead, 2020). The study used non-participant observation to explore suitable African play-based activities and their role in the online teaching of mental mathematics to FP learners. Furthermore, non-participant observation was used to triangulate the data from interviews with document data to authenticate the

relationship between lesson plans, what was implemented in the classrooms, and learners' achievement in mathematics activities.

Chen (2021) and Dyar (2022) presented a comprehensive review on instructing researchers on using non-participant observation within hermeneutical phenomenology research design to understand the study phenomenon without participating. The description of how non-participant observations were used in this study is found in Section 4.7.3. The data analysis strategy is reviewed in the next section, which assists in analysing data from three (3) data sets.

1.6.6 Data Analysis and Interpretation

In qualitative research, data analysis systematically collects and arranges data from collection tools that the researcher has chosen to increase the understanding of the phenomenon (Mamokhere, Lavhelani & Netshidzivhani, 2021). Adu (2019) emphasised that the data needs to be well managed because of its in-depth nature through coding. Against this background, data analysis involves gathering and organising data from selected research collection tools to manage it.

Data analysis techniques include qualitative content, narrative, discourse, thematic, grounded theory, and interpretative phenomenology (Neville & Whitehead, 2020). The researcher used the Interpretive Phenomenological Analysis (IPA) strategy in this study. Rajasinghe (2020) supports the idea that this strategy helps researchers explore participants' personal experiences to understand the phenomenon. The data from interviews, documents and observations was analysed through NVivo 14. Like other IPA researchers, the data was coded on the software, and later visualisations such as tree maps, word clouds, networks and sunbursts were exported. This assisted in the presentation of results in Chapter 5.

1.7 MEASURES OF TRUSTWORTHINESS

Trustworthiness or rigour of a study refers to the degree of confidence in data, interpretation and methods used to ensure the quality of a study (Johnson, Adkins & Chauvin, 2020). Rose and Johnson (2020) indicated that it refers to the quality, authenticity and truthfulness of qualitative research findings, including credibility,

transferability, dependability and confirmability. In this study, the researcher ensured trustworthiness by integrating the elements of credibility and reliability.

1.7.1 Credibility

Credibility measures how true-to-life a qualitative study is or how accurate and reliable its conclusions are (Lemon & Hayes, 2020). CohenMiller, Saban and Bayeta (2022) recommend several techniques researchers may use to enhance the credibility of their research, including prolonged engagement, persistent observation, triangulation, peer debriefing, negative case analysis, progressive subjectivity checks and member checking. The researcher used prolonged engagement, persistent observation, peer debriefing, member checking and method triangulation to establish the credibility of this study.

1.7.1.1 Prolonged engagement

Johnson et al. (2020) explained that the researcher must spend sufficient time in the field to learn or understand the phenomenon of interest. For the researcher to gain in-depth data on the views and experiences of educators in using Africanised play-based pedagogy, prolonged engagement was applied during the interview process, during which the researcher asked probing questions depending on the educators' responses.

1.7.1.2 Persistent observation

To be persistent, Lemon and Hayes (2020) stated that the researcher should explore the details of the phenomenon under study to ensure the depth of experiences. The researcher also engaged in non-participation observation to see and hear educators integrating Africanised play-based pedagogy into online teaching of mental mathematics to FP learners.

1.7.1.3 Peer debriefing

The researcher asked one of her colleagues, who holds impartial views of the study, to examine the data transcripts. Nowell and Albrecht (2019) supported the idea that the role of peer debriefing in qualitative research is to uncover errors, detect biases and improve the quality of a study by establishing credibility and ensuring validity.

1.7.1.4 Member checking

The researcher returned data to educators to verify the accuracy and gain clarity on their experiences. Candela (2019) asserted that member checking in qualitative research is used to ensure the credibility of the results. Negative case analyses or alternate explanations were not available.

1.7.1.5 Methodological triangulation

Triangulation is confirming findings by including relevant literature, using multiple research instruments, and (typically) conducting observations with multiple researchers (Stahl & King, 2020). The researcher used a combination of semi-structured interviews, document analysis and non-participant observation to collect data since she acknowledged that a single truth could not determine reality. The following section discusses the dependability of this study.

1.7.2 Dependability

Dependability refers to the consistency and reliability of the valid research findings (Hasan, Rana, Chowdhury, Dola & Rony, 2021). Nowell and Albrecht (2019) suggested techniques to establish dependability, including establishing an inquiry audit, a detailed description of the study methods and data replication. Nassaji (2020) added that dependability supports the idea of internal validity in qualitative research. The researcher used an inquiry audit and internal validity to ensure consistency and reliability of findings.

1.7.2.1 Inquiry audit

Sileyew (2019) proposed that the researcher should involve a person not involved in the data collection to examine the data analysis process to confirm the accuracy of the findings. In the data analysis process, the researcher coded data and wait several days to recode the same data to compare the consistency of codes. The researcher asked her supervisor to co-code the same data to validate the analysis and present them as findings. Linneberg and Korsgaard (2019) advised assessing the validity of text data coding.

1.7.2.2 Internal validity

Stenfors, Kajamaa and Bennett (2020) explained that in qualitative research, the "appropriateness" of the methods, procedures and data constitutes validity. For this study, validity refers to the degree to which a researcher's findings accurately reflect the phenomenon they aimed to understand. This study corroborated data from semi-structured interviews with the findings from the observations to ensure validity. The researcher used audio recordings to capture interview conversations to reduce internal bias.

1.8 RESEARCH ETHICS

Quantitative and qualitative research researchers must adhere to ethical standards (Johnson et al., 2020). They provide, educate, guide, and govern the standards of conduct for scientific researchers to ensure a high ethical standard (Mittelstadt, 2019). Pietilä, Nurmi, Halkoaho and Kyngäs (2020) outlined the fundamental principles of ethics in research, including voluntary participation, informed consent, anonymity, confidentiality, the potential for harm and results from communication, the researcher adhered to all the principles. Therefore, before data collection began, the following approvals and permissions were obtained to conduct this study:

1. Ethical approval from the University of South Africa (UNISA) Ethics Committee with reference number **2023/10/11/64019209/38/AM.** (Appendix A).
2. Permission to conduct research from the Limpopo Provincial Department of Education (LPDE). (Appendix B).
3. The certificate from Limpopo Provincial Research Ethics (LPRE) was approved by the premier's office with research project number **LPREC/144/2023: PG.** (Appendix C).
4. Upon receiving approval from the DBE, the researcher sent letters to the principals of the identified schools to request permission to collect data at their schools. The permission was granted. (Appendix D).
5. Parents and participants also consented to the researcher accessing the data from their children's activity books. There were also assent forms for learners. (Appendix E and F).
6. To safeguard anonymity and confidentiality, the researcher replaced the names of schools and participants with pseudonyms during data analysis and discussions.

1.9 LIMITATIONS AND DELIMITATIONS

1.9.1 Limitations

Limitations are restrictions, making them virtually uncontrollable by the researcher. Still, they might impact the study's design, findings and conclusions. Therefore, it is crucial to work toward acknowledging the research's breadth and extent of limitations throughout the research process (Theofanidis & Fountouki, 2019). In this respect, this study was constrained by certain limitations identified for this research inquiry.

1. The qualitative methodology is the first limitation. The researcher only had access to a small geographic area, which did not provide a broad scope of responses, and data saturation would not have been achieved when exploring educators' views and experiences on using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. The use of IPA is another potential area where data cannot be accurately replicated and consequently cannot be confirmed in and of itself.

2. Another potential limitation was locating public primary schools that provided online teaching to FP learners.

3. The last limitation was the duration of semi-structured interviews. Long-lasting conversations with educators during the interviews could have resulted in withdrawal or limited them from providing in-depth information. This could have restricted the study by skewing the findings.

1.9.2 Delimitations

Theofanidis and Fountouki (2019) indicated that theoretical background, objectives, research questions, variables under study and study sample are the primary delimitations the researcher can control. In light of this, this study focused on public primary schools and those chosen based on how they have implemented CAPS. She used comparable legal frameworks that directed her to use Africanised play-based pedagogy in the FP of teaching. Educators were selected using homogenous purposeful sampling from the available educators because they were expected to understand and use Africanised play-based pedagogy when teaching FP learners in mental mathematics.

1.10 SIGNIFICANCE OF THE STUDY

This study is unique in that it responds to a call for Africanisation, decolonisation and digitalisation of the mathematics curriculum arising from concerns about the alarmingly poor results in mathematics in South African schools. The significance of this study lies in the use of play-based activities that have African knowledge, culture and background in the online teaching of mental mathematics to FP learners in South Africa. In addition, it includes contributions to policy development in FP mathematics. The official South African government school curriculum policy includes study units that value indigenous knowledge in the field of mathematics (DBE, 2011). In similar vein, the curriculum mentions using the components of ethnomathematics in teaching mathematics to foundation-phase learners. However, educators must learn how to apply this theory in teaching and learning activities.

1.11 DEFINITIONS OF KEY CONCEPTS

1.11.1 Play-Based Pedagogy

The teaching method known as play-based pedagogy uses play-based activities to help learners develop new skills (Hedges & Cooper, 2018). Furthermore, Robertson, Morrissey and Rouse (2018) elucidated how child-initiated and teacher-supported learning are combined. Taylor and Boyer (2020) also showed that children can actively and imaginatively interact with people, things and the environment through play-based learning. With this context in mind, play-based pedagogy in this study refers to a learning strategy that actively engages, interacts and co-creates learning through play to help young learners build their social and problem-solving skills.

1.11.2 Africanised Play-Based Pedagogy

Africanised play-based pedagogy is a term for a play-based method of teaching that incorporates African customs, knowledge and culture (Sebola & Mogoboya, 2020). Suárez-Orozco, Motti-Stefanidi, Marks and Katsiaficas (2018) explained how including cultural components in play helps learners understand and embrace their culture. Thus, problem-solving abilities can be developed using African games and songs to teach mathematics.

1.11.3 Online Teaching

While a solid link has been established between the face-to-face mode of teaching and play-based pedagogy in the FP, South African education has also undergone a tremendous technological transformation as part of digitalisation. The COVID-19 pandemic has added impetus to the transition from face-to-face to online teaching and learning. Ali (2020) explains that different pedagogical strategies, subject areas, lesson plans, interaction models and assessment techniques are blended into online teaching. The method of conveying knowledge through interactive multimedia tools, including computers, cellphones, tablets, televisions and social media, is known as online teaching and learning(Maphosa, 2021). Kaup et al. (2020) state that additional techniques, including webinars, group video calls and one-on-one video conversations, can be used.

Online teaching is a method that puts the focus on the learners and raises their levels of interest and participation in virtual classrooms (Iyer et al., 2020). For this study, online teaching is a method that puts the learner's needs first. Teachers do this by distributing educational materials to learners via online platforms. Moreover, online teaching integrates the use of digital tools and technologies to impart knowledge. It can involve numerous tools such as the use of technological devices, digital resources, interactive content, and learning management systems.

1.11.4 Mental Mathematics

Pourdavood et al. (2020) defined mental maths as a process of working out maths calculations and carrying out problem-solving mentally. Venkat et al. (2021) mentioned that developing problem-solving skills is the foundation for developing mental math skills in FP learners. Umbara et al. (2021) indicated that African games that improve problem-solving skills can be used to teach mental math using a play-based strategy. The capacity to solve math problems mentally is referred to in this study as mental mathematics. Using Africanised play-based pedagogy may aid in developing problem-solving skills in FP learners.

Umbara et al. (2021) recommended that play-based pedagogy should be used to teach mental mathematics through games that improve problem-solving abilities. Simply put, mental mathematics involves performing calculations and problem-solving

in one's head (Pourdavood et al., 2020). So far, play-based pedagogy has only been applied to face-to-face teaching since no education policies support it in online learning. Moreover, more studies are needed on using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. It is against this background that the researcher saw a need to explore the use of Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners.

1.11.5 Foundation Phase Learners

In the South African educational system, children in Grades 1, 2, and 3 between the ages of 6 and 9 are referred to as FP learners (Spaull, 2015). Generally, in this phase, reading, writing, and numeracy skills are developed (de Waal, 2019). Wainwright, Goodway, John, Thomas, Piper, Williams and Gardener (2020) demonstrated that using play-based pedagogy to cultivate these skills effectively lays the framework for learning.

1.12 CHAPTER OUTLINE

The following chapters are included in this study:

The introduction and background of this study are presented in **Chapter 1**. It also included a problem statement, study aim, objectives, questions and literature review. A summary of the research methodology and definitions of the essential terms used in this study were provided.

The theoretical foundation is covered in **Chapter 2**. In light of using an Africanised play-based pedagogy for FP learners learning mental mathematics online, this chapter aimed to analyse the application of the two proposed theories, ethnomathematics and Vygotsky's sociocultural theory. To provide some techniques for implementing Africanised play-based pedagogy when teaching FP learners in mental mathematics online, the essential concepts of these two theories are related.

Chapter 3 presents a detailed review of the literature on using Africanised play-based pedagogy when teaching mental mathematics to FP learners and gave a systematic review of other scholars' work on the phenomenon. A critical review of the subject's challenges, knowledge gaps and strengths is identified to establish a theoretical

understanding of the study. This chapter also looks into the legal frameworks that influence play-based teaching that has been Africanised nationally and internationally.

In **Chapter 4**, the researcher provides specific details on the research approach, design and procedures used. The study's data analysis, participant sampling, quality standards, data collection and ethical considerations are also explained in detail.

Chapter 5 discusses the analysis and interpretation of the research data through IPA. The data collected from semi-structured interviews, document analysis and non-participant observation is presented and discussed through the lens of the theoretical framework and reviewed literature.

Chapter 6 provides a summary of critical scholarly and empirical findings. Conclusions for each research question are provided. The recommendations and a suggested framework concerning the study's findings are also discussed.

1.12 CHAPTER SUMMARY

This suggested study's introduction and background were discussed, along with a broad overview of the use of play-based pedagogy in the online teaching of mental mathematics to FP learners. The problem statement, research questions, aim and objectives were also included. Furthermore, the research methodology, paradigm, approach, design and data collection methods were outlined, as well as the study population, sampling strategies and data analysis techniques. It offers trustworthiness and research ethics. The next chapter presents the theoretical framework underpinning this study.

CHAPTER 2: THEORETICAL FRAMEWORK

2.1 INTRODUCTION

This chapter starts by describing the theory of ethnomathematics, unpacking its six critical dimensions to analyse the sociocultural roots of mathematical knowledge. The chapter further presents Vygotsky's sociocultural theory, discussing concepts relevant to Africanised play-based pedagogy in teaching FP learners mathematics. Lastly, the researcher emphasises what these two theories have in common concerning this study.

Kivunja and Kuyini (2017) and, Chijioke, Ikechukwu & Aloysius (2021), and Smith, Wofford, Friedensen, Stanfield and Jackson (2021) explained that the purpose of the theoretical framework is to structure and support the study through selected theory/ theories that are relevant to the topic. Reflecting on this rationale, the problem statement, the research questions and the objectives, this study adopts the theory of ethnomathematics and Vygotsky's sociocultural theory as a guiding theoretical framework. Most importantly, educators need to understand them and be able to apply them in the use of Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners.

The theoretical framework will also support the literature review, research methodology, data analysis, findings, recommendations and conclusions of this study. The theory of ethnomathematics and Vygotsky's sociocultural theory helped to contextualise the literature review in the chapter to understand why the research problem in this study exists concerning the broader areas of knowledge being considered and to assist in answering the research questions formulated in Section 1.3.1 (Kivunja & Kuyini; 2017; Nilsen et al., 2020). The philosophical, epistemological, methodological, and analytical discussion of the theory of ethnomathematics and Vygotsky's sociocultural theory will assist in selecting the research methodology and choosing a suitable data analysis strategy for this study (Grant & Osanloo, 2014, Rashid et al., 2019; Varpio et al., 2019).

Kivunja (2018) explained that a theoretical framework supports or contradicts the research findings. Understanding Kivunja's (2018) theory of ethnomathematics and Vygotsky's sociocultural theory helped to support the conclusions in Section 6.4.

Kivunja (2018) supported Deterding and Waters (2021) and Kivunja and Kuyini (2017), who mentioned that the selected theories make the research findings significant and acceptable. These theories assisted in formulating suggested strategies that could support educators when using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners in Section 6.7.

2.2 THEORY OF ETHNOMATHEMATICS

The theory of ethnomathematics was developed in 1977 by Ubiratan Ambrosio, a Brazilian mathematician and educator. Ethnomathematics comprises the terms "*Ethno*" and "*mathematics*". Johnson, Smail, Corey and Jarrah (2022) indicated that the term "*Ethno*" refers to the components of a group's cultural identity. At the same time, mathematics is the language of employing numbers to solve problems (DBE, 2011). Initially, the theory of ethnomathematics was restricted to illiterate individuals, but in the early 1980s, it was later shifted to classroom settings. According to Acharya, Kshetree, Khanal, Panthi and Belbase (2021), the theory of ethnomathematics acknowledges the relationship between culture and mathematics.

Furthermore, integrating mathematics and culture enhances people's creativity within a cultural group (Acharya et al., 2021). Similarly, Mania and Alam (2021) agreed that the purpose of the theory of ethnomathematics is to further the understanding of culture and mathematics, primarily by highlighting the linkages between these two. Consequently, the researcher's perspective and understanding of ethnomathematics theory have been shaped by the works of Acharya et al. (2021) and Mania and Alam (2021), which suggest that the theory aims to elucidate mathematics within cultural contexts. This implies that culture plays a significant role in fostering the development of mathematical proficiency.

Nur, Kartono, Zaenur, Waluya and Rochmad (2020) explained that ethnomathematics benefits the philosophy and culture of mathematics, political mathematics and mathematics education. Mania and Alam (2021) argued that since the theory of ethnomathematics is based on cultural activities, it should be integrated into mathematics in the classroom. The theory of ethnomathematics links perfectly with using Africanised play-based pedagogy in teaching mental mathematics to FP learners. This is due to potential pedagogical implications for how learners are taught

mathematics in the FP. Against this backdrop, the theory of ethnomathematics connects to the aim of this study. The perspectives of ethnomathematics theory seek to explain the application of dimensions in teaching mathematics.

2.2.1 Six Dimensions of the Theory of Ethnomathematics

This section discusses the six interrelated dimensions proposed by Rosa and Orey (2016): cognitive, conceptual, educational, epistemological, historical and political. They all contribute to the teaching and learning of mathematics as they aim to analyse the sociocultural roots of mathematical knowledge.

2.2.1.1 Cognitive

Evidence from Rosa and Orey (2016) and Umbara, Wahyudin and Prabawanto (2021) emphasised that social and cultural contexts trigger cognitive and mental development in individuals. This indicates that mathematical thinking skills are developed when learners engage in activities linked with social and cultural aspects (Rosa & Orey, 2016). As highlighted by Sunzuma and Maharaj (2020), the theory of ethnomathematics helps to develop learners' cognitive thinking that assists in learning mathematics. The researcher, thus, understands that social and cultural background has an influence on the cognitive development of learners in terms of mental and mathematical thinking.

As such, the researcher acknowledges that the theory of ethnomathematics could be used in understanding a learner's cognitive development. Cognitive development in young learners fosters mental and mathematical thinking skills (Rosa & Orey, 2016; Umbara et al., 2021). Against this background, the researcher agrees that the learner's cognitive skills should be first developed by teaching mental mathematics.

2.2.1.2 Conceptual

Rosa and Orey (2016) argued that social, cultural, economic, environmental and political contexts positively affect conceptual knowledge. Sunzuma and Maharaj (2020) maintained that teaching mathematics through integrating cultural values instils basic mathematics concepts. For this study, the researcher concurs with the authors, as mentioned earlier, that educators must use Africanised-based pedagogies to teach

mathematical concepts. Learning mathematics becomes more meaningful when learners participate in play-based activities that infuse African culture and improve their understanding of the concepts grasped. As a result, educators need to use Africanised play-based pedagogy in teaching FP learners to develop concepts related to mental mathematics.

2.2.1.3 Educational

On the one hand, from the theory of ethnomathematics perspective, educational implications for schools are that they should integrate the learners' cultural background into teaching. Mogari (2014) enlightens that ethnomathematics approaches are also learner-centred and activity-oriented. This is consistent with South African mathematics in the FP (DBE, 2011). On the other hand, transformations in the social, cultural, technological and political framework have affected the teaching and learning of mathematics in schools. This leads to teaching mathematics using technology platforms to address new realities, promoting relevant and authentic learning experiences (Umugiraneza et al., 2018) – in this instance, teaching mental mathematics using online platforms. Similarly, Brandt and Chernoff (2015) and Sunzuma and Maharaj (2020) agreed that educators should incorporate elements of ethnomathematics theory using technological means when teaching mathematics.

2.2.1.4 Epistemological

Epistemological changes are involved in the ethnomathematics theory. Nevertheless, Umbara et al. (2021) explained that philosophical views from ontological and epistemological aspects indicate that there is a significant relationship between culture and mathematics. On the same note, Rodríguez-Nieto and Alsina (2022) highlighted that using play-based pedagogy is among the epistemological aspects of ethnomathematics theory. While teachers possess ethnogeometric knowledge, demonstrated by their incorporation of cultural dances and games in mathematics instruction, Sunzuma and Maharaj (2020) mooted the need to provide training in ethnomathematical approaches. In light of this, the researcher aligns with Sunzuma and Maharaj's (2020) assertion that it remains imperative to gather educators' perspectives, experiences and beliefs regarding the use of Africanised play-based pedagogy for teaching mental mathematics to FP learners.

2.2.1.5 Historical

Not only does literature from Li and Schoenfeld (2019) promote the use of historical content in mathematics lessons, but the curriculum also encourages educators to acknowledge the rich history and heritage of South Africa when teaching FP learners (DBE, 2011). Chirinda, Ndlovu and Spangenberg (2021) affirmed that the benefits of using historical facts and ideas in teaching mathematics support understanding. Bose and Seetso (2016) confirmed that Diketo, a traditional game, is played in South Africa and other African countries to teach counting. Consequently, these authors showed that traditional games are part of the historical content integrated into teaching mathematics. The researcher thus posits that historical mathematical ideas used in the past could assist educators in teaching mental mathematics.

2.2.1.6 Political

There is a strong link between social reality and politics in teaching mathematics. Rosa and Orey (2019) affirmed that culture and political practices can be used in mathematical learning. This is consistent with Bakker, Cai and Zenger's (2021) study, which stated that maintaining a socio-political context in teaching mathematics is helpful since it increases learners' problem-solving skills. Other than problem-solving skills, Kundu, Bej and Rice (2021) advocated that incorporating politics increases teachers' and learners' interest and motivation in mathematics and literacy. Shum and Luckin (2019) explained that to teach mathematics using politics, the teacher can use statistics, assumptions and decisions made by politicians. As such, the researcher agrees with Shum and Luckin (2019) that the method that politicians use to count the population in South Africa can be adopted by teachers when teaching counting.

All these dimensions emphasise the importance of culture in teaching mathematics. The researcher concurs that cultural activities such as Africanised play-based pedagogy could be used to teach mental mathematics to FP learners. Drawing from Bakker et al. (2021), Brandt and Chernoff (2015), and Sunzuma and Maharaj (2020), cultural activities play a significant role in teaching and learning mathematics. Their role is unpacked in the next section.

2.2.2 The Role of Cultural Activities in Teaching and Learning Mathematics

Research by Acharya et al. (2021), Brandt and Chernoff (2015) and Andros and Orey (2016) indicated that it is critical to acknowledge the cultural context by incorporating cultural activities that learners understand into teaching mathematics as this has many benefits. Mania and Alam (2021) explained that cultural activities play a significant role in teaching and learning mathematics. White, DuCloux, Carreras-Jusino, González and Keels (2016) outlined that cultural activities should be reflected and embraced in teaching and learning mathematics Chikodzi (2022) believed that multicultural classrooms expose learners to cultural examples so that they can understand mathematical concepts. In addition, Darling-Hammond Flook, Cook-Harvey, Barron and Osher (2020) indicated that cultural examples can increase social awareness among learners and offer them alternative ways of learning multiplication. Fouze and Amit (2017) found that folklore stories in teaching mathematical concepts increase learners' numbering abilities. Palhares and Shirley (2015) affirmed that integrating cultural values in teaching and learning helps develop geometry skills. Combining cultural activities and mathematics learning enhances learners' ability to identify different shapes and brings engagement in the classroom (Mania & Alam, 2021).

Drawing from the scholars mentioned earlier, cultural activities play an essential role in mathematics content areas such as numbers, operations and relationships, as well as geometry (space and shapes) in the FP. From the researcher's perspective, the role of cultural activities in these content areas is to promote learners' problem-solving skills. This is supported by several researchers, such as Acharya et al. (2021), Brandt and Chernoff (2015), and Rosa and Orey (2016), that the role of integrating cultural activities in the classroom is to develop learners' problem-solving skills in mathematics. Brandt and Chernoff (2015) further advised that mathematics educators should incorporate cultural activities into their lesson plans. From those mentioned earlier, the researcher confirms that the role of cultural activities in teaching and learning mathematics is to develop problem-solving skills.

Previous research has shown that educators play a significant role in developing problem-solving skills through cultural diversity when teaching mathematics. Rosli and Lin (2018) state that teachers must consider the varying cultures and requirements of diverse groups of children to ensure that problem-solving skills are effectively

developed when teaching mathematics. Although Bose and Seetso's (2016) and Khatri's (2020) studies did not mention mathematics, their relevance to this study is based on their remarks that teachers must provide opportunities to integrate cultural diversity into the school curriculum to improve problem-solving skills among learners.

This is consistent with researchers such as Widada, Herawaty and Lubis (2018) and Nur et al. (2020), who maintain that using cultural activities in teaching and learning enhances learners' ability to solve mathematical problems. Widada et al. (2018) affirmed that it develops learners' problem-solving skills when solving mathematical problems. In addition, Nur et al. (2020) asserted that cultural activities influence learners' ability to develop problem-solving skills based on their cognitive level of thinking. However, Clivaz and Miyakawa (2020) had different views on the use of cultural activities in teaching mathematics since it might be difficult for an educator to accommodate the individual differences of each learner and their varied cultural backgrounds. In this study, the researcher remarks that educators must employ play-based pedagogy when teaching mental mathematics in the FP to develop learners' problem-solving skills as their cognitive levels are still developing.

Other than the development of problem-solving skills, Archaya et al. (2021), Palhares and Shirely (2015) and Patri and Heswari (2021) posited that the integration of cultural activities in the teaching of mathematics develops learners' mathematical thinking. Archaya et al. (2021) posited that including cultural activities can make mathematics more accessible to learn and teach, which might help develop learners' mathematical thinking skills. Palhares and Shirely (2015) mentioned that it has a beneficial effect on improving learners' mathematical thinking processes. Patri and Heswari (2021) also highlight that cultural activities increase learners' motivation and logical thinking skills.

The researcher believes that Africanised play-based pedagogy should be used in teaching and learning mental mathematics to develop learners' problem-solving and logical thinking skills. This view is supported by Fouze and Amit (2017), who believed that playing African games helps develop problem-solving skills and mathematical thinking that help in teaching and learning mathematics. Acharya (2021) concluded that one way of decolonising education is by transforming the curriculum by infusing cultural rituals, artefacts and cultural play to teach basic-level mathematics. Since this study aims to explore the use of Africanised play-based pedagogy in the online

teaching of mental mathematics to FP learners, the researcher sees the need to integrate Africanised play-based pedagogy when teaching mathematics.

2.2.3 Integration of Africanised Play-based Pedagogy in Teaching and Learning Mathematics

The previous section emphasised that the prominent role of using cultural activities in teaching and learning mathematics is to develop problem-solving skills. Mathematical thinking skills were also put forward. In this section, the researcher discusses the importance of integrating Africanised play-based pedagogy in teaching mathematics. Some evidence from Moloi, Mosia, Matabane and Sibiya (2021) suggested that ethnomathematics is a dynamic and play-based teaching method that improves learners' understanding of word problems in mathematics classes. Drawing from Moloi et al.'s (2021) view, the researcher notices that Africanised play-based pedagogy could be integrated into teaching and learning mathematics to young learners.

Bose and Seetso (2016), Fouze and Amit (2017), Mosimege (2020), Setiyadi, Mulyonoand Dwidayati (2018) corroborated that African games benefit teaching and learning mathematics. Bose and Seetso (2016) stated that an African game called "Diketo," played in Botswana, helps educators teach young learners science and mathematics. In addition, Fouze and Amit (2017) indicated that playing culture-based games can be used as a teaching strategy in mathematical education. Furthermore, Mosimege (2020) notes that playing African games enables learners to connect learning mathematics in the classroom to circumstances in their real-life contexts. Similarly, past literature from Setiyadi et al. (2018) showed that play-based learning is made possible by African games that connect mathematics and the learners' everyday lives.

Literature suggests that cultural play enhances mathematical skills (Handayani & Iswantiningtyas, 2020). For example, an Indonesian traditional game called "Bermain Satu Rumah" supports children's counting skills (Nasrullah & Zulkardi, 2011). The study of Handayani and Iswantiningtyas (2020) revealed that learners can learn social skills and mathematical principles, such as addition and subtraction, and shapes while playing traditional Javanese games. Tachie and Galawe (2021) highlighted that "*Morabaraba*," an indigenous game in South Africa, can be used to teach number

sentences and geometric patterns. Moloi et al. (2021) recommended that African games regarded as indigenous games in South Africa be integrated into teaching learners how to solve mathematics word problems. Based on this recommendation, the researcher believes that traditional games can be used as a teaching strategy to develop learners' problem-solving skills when teaching mathematics. This is supported by Mosimege (2020), who stated that indigenous games assist in developing problem-solving and critical thinking skills among learners.

The literature review suggests that integrating play-based pedagogy with cultural activities develops learners' problem-solving skills in teaching mathematics, which emerges from ethnomathematics. Through examining how Africanised games can support the teaching and learning of mathematics, it is the intention of the researcher to explore how Africanised play-based pedagogy can be used in the online teaching of mental mathematics to FP learners in the twenty-first century, hence, the present study. Given the rapid development of technology, it is essential to incorporate Africanised play-based pedagogy into the online teaching of mental mathematics to young learners. In support of this view, Mania and Alam (2021) stated that educators must use technology as a tool to develop learners' mathematical problem-solving skills by integrating ethnomathematics.

2.3 VYGOTSKY'S SOCIOCULTURAL THEORY

Many researchers have adopted Vygotsky's sociocultural theory in teaching and learning in ECE. Sociocultural theory was developed by a Russian psychologist and theorist, Lev Semyonovich Vygotsky, in the 1930s. This theory assumes that social interactions and cultural factors play a significant role in a child's cognitive development. Dai (2020) and Eccles and Wigfield (2020) agreed that social interaction and the cultural context foster a learner's cognitive development. Dai (2020) confirmed that the social and cultural framework in which an individual's growth is entrenched is necessary to shape their understanding. As such, Eccles and Wigfield (2020) concurred that understanding a learner's social, cultural and historical context is essential before comprehending their cognitive growth. Alkhudiry (2022) and Veraksa, Colliver and Shukhikh (2022) highlighted that, based on Vygotsky's perspective, social interaction is vital for a learner's cognitive development, which varies among cultures.

Thus, the researcher understands that varied cultures play different roles in a learner's cognitive development.

Vygotsky's theory focuses on how social interaction and culture might help young children develop their mental abilities and problem-solving capabilities. Albusaidi (2019) pointed out that social contact and culture play a role in developing higher-order thinking abilities. Vygotsky (1967) asserted that higher-order thinking abilities are developed due to social interaction and cultural aspects. Chirkov (2020) affirmed that learners' social interactions and the culture in which they are raised influence their mental abilities. Ameri (2020) declared that higher mental functions, defined by Vygotsky's sociocultural theory, are efficiently developed through contextual interaction.

Vygotsky's sociocultural theory, which asserts that social interaction and the cultural context are crucial for developing high mental skills, fits well with using Africanised play-based pedagogy in teaching mental mathematics in ECE classrooms. In this case, we see that the field of ethnomathematics fits squarely with the application of Vygotsky's sociocultural theory viewed through the lens of Africanised play-based pedagogy in teaching mathematics to ECE learners. For further clarity, 'play' represents the social interaction while 'Africanised' speaks to the cultural context. In support of this, Vygotsky's theory emphasises the importance of social interaction and cultural context in developing learners' mental abilities and problem-solving skills (Ameri, 2020). Even though this theory is not focused on how to teach and learn mathematics, it is crucial to stress that teaching mental mathematics requires a strong foundation in cognitive skills and problem-solving techniques.

Two principles of Vygotsky's sociocultural theory, namely, the ZPD and the MKO, were found to be crucial to learners' cognitive development as a socially and culturally mediated process in which they acquire problem-solving abilities (McLeod, 2018). In play-based learning, the ZPD functions through several key mechanisms. Educators (known as MKOs) initially observe children's play to assess their skills and identify activities slightly beyond their current abilities. Subsequently, educators provide scaffolding by offering support and guidance tailored to bridge the gap between children's existing skills and the task at hand within the ZPD, employing methods such as modelling and questioning. Collaborative play allows for social interaction and

teamwork, so that children to learn from peers and adults within their ZPD. As children become more competent, educators gradually release responsibility, enabling them to tackle increasingly challenging tasks independently, thereby expanding their ZPD. Finally, play-based environments encourage reflection and feedback, aiding children in recognising their progress and areas for further growth within the ZPD. Thompson (2022) defined the MKO as an individual with a better understanding or a higher skill than a learner. ZPD refers to the gap between actual and potential learning as measured by a person's independence when solving problems(Kusmaryono et al., 2021). Many academics often use the principles of the ZPD without emphasising the importance of the MKO in applying the former. This study makes the case that one can only adopt ZPD with MKO because MKO's role in using ZPD is to improve the learner's problem-solving skills, as they will better understand the importance of social interaction and culture than the learner. This argument is authenticated by several researchers, such as Alkhudiry (2022), Gehlot (2021) and Silalahi (2019), who showed the importance of MKO's collaboration in the application of ZPD.

Alkhudiry (2022) mentioned that the collaboration of the teacher and knowledgeable peers in the ZPD promotes efforts to advance learners' capacity to solve problems and boost their independence. Gehlot (2021) also stated that it is only through collaboration with adults and other learners that this gap can be closed through play-based activities. Silalahi (2019) stipulated that problem-solving skills and prospective development are assessed with the help of adults or in cooperation with more experienced peers. Recently, Sage (2022) explained that the help of an adult is needed to increase a learner's potential cognitive level. Based on Kivunja and Kuyini (2017) statement that selected theories help the researcher to understand the research question, Vygotsky's sociocultural theory assists in understanding research sub-question 1: *What role does Africanised play-based pedagogy perform in the online teaching of mental mathematics to FP learners?* Against this backdrop, the researcher notes the role of using Africanised play-based pedagogy in teaching mental mathematics to FP learners to develop problem-solving skills through applying the ZPD. Keeping this background in mind, the researcher explains the significance of the ZPD in using Africanised play-based pedagogy in teaching mental mathematics to FP learners as follows.

2.3.1 The Principles of Zone of Proximal Development (ZPD)

Using the principles of the ZPD in teaching young children mathematics was discussed in the section above. This section examines how the ZPD can be used in teaching mental mathematics and improving learners' problem-solving skills. This study uses the definition of ZPD proposed by Kusmaryono et al. (2021), which refers to the difference between actual and potential learning given an individual's problem-solving independence. Furthermore, it acknowledges the crucial role the MKO plays in bridging the gap to develop problem-solving skills among learners. Li (2022) claimed that Vygotsky believed that educators (as MKOs) could close the gap to expand learners' mental skills, which are crucial in mental mathematics, using play-based pedagogy. In his book entitled "*Play and Its Role in the Mental Development of the Child*," Vygotsky (1967:16) made a point of highlighting this claim (Li, 2022). According to Vygotsky (1967: 16), "*In play, a child is always above his average age, above his daily behaviour; in play, it is as though he were a head taller than himself*." It is further asserted by Smolucha and Smolucha (2021) that children's development is a result of play. Play-based learning often involves collaboration with peers or adults. Through interactions with others, children can learn from each other and receive assistance within their ZPD. Collaborative play encourages social interaction, communication, negotiation and teamwork, all of which contribute to learning within the ZPD.

Loizou and Loizou (2022) explain that educators and parents can use play-based learning environments to encourage reflection and provide feedback to support children's learning within the ZPD by providing children with play-based activities that incorporate culture to encourage social interactions. They added that learning through such experiences fosters the development of learners' mental abilities and problem-solving skills, which are critical in cognitive development (Loizou & Loizou, 2022). Fidele et al. (2019) and Twumasi and Afful (2022) enlightened us that the advantages of using play-based pedagogy in the classroom are the development of mathematical vocabulary and problem-solving skills. Kusmaryono et al. (2021) clarified that through this pedagogy, the teacher (as the MKO) allows learners to deal with mathematical problems on their own and later share problem-solving strategies with them. The

educator may use free play[1] to allow learners to deal with mental mathematics problems on their own and use guided play[2] To close the gap by providing problem-solving strategies will enable them to solve those problems on their own or during the assessment process. Against this background, the researcher notes the importance of applying play-based pedagogy when to help learners build their problem-solving skills when learning mental mathematics.

In contrast, Poehner, van Compernolle, Esteve and Lantolf (2018) and De Florio (2022) identified two (2) limitations on the use of ZPD in teaching young children. The first limitation is put forward by Poehner et al. (2018), who stated that MKOs' assistance to children frequently restricts the use of ZPD in learner-centred settings. The second limitation of ZPD is its ambiguity, which illustrates how various learners may face broad or specific constraints when trying to build their problem-solving abilities (De Florio, 2022). Based on the principles of Vygotsky's sociocultural theory, this demonstrates the necessity for MKOs, including teachers, peers or community leaders, to engage learners in African games that they are familiar with to develop their mental abilities and problem-solving skills through social interactions within a particular cultural setting when teaching mental mathematics. Vygotsky's ideas show that educators could use Africanised play-based pedagogy to teach mental mathematics to FP learners. Rosli and Lin (2018) showed that when learners participate in play-based activities in a mathematics class, there is a chance that they will interact with the teacher, their peers and each other. This led some educators to use Africanised play-based pedagogy in teaching and learning mathematics, emphasising certain cultural norms and social interaction (Matthews & López, 2020).

Teachers could also benefit from using Africanised play-based pedagogy by assisting learners in developing their problem-solving abilities, which are helpful in mental mathematics.Szymkowiak, Melović, Dabić, Jeganathan and Kundi (2021) pointed out that social interaction opportunities in society have significantly increased because of technology. Ameri (2020) confirmed that computer technology is also seen as a

[1] Free play is an unstructured, self-initiated activity that children can engage in to expand their imaginations(Brown & Lynch, 2022).
[2] The term "guided play" describes educational activities that mix the child-directedness of "free play" with an emphasis on learning objectives and adult mentoring (Yu, 2022).

cultural tool teachers can use to develop social interaction between educators and learners in teaching and learning activities. Because of its affordances, Computer-Supported Collaborative Learning (CSCL) opens up new possibilities for implementing sociocultural approaches by enabling MKO and ZPD to work together effectively in real-world, blended and online settings (Hernández-Sellés, Muñoz-Carril & González-Sanmamed, 2020). Even though Russian theorists created the sociocultural theory, Mutekwe's (2018) study found that South African practitioners may use it to foster the development of problem-solving and mental skills through play. Against this backdrop, Mutekwe's (2018) study suggested that Africanised play-based pedagogy could be used in the online teaching of mental mathematics to develop problem-solving skills through the ZPD. The role of the MKO in teaching mathematics is discussed in the next section.

2.3.2 The Role of MKO in Teaching Mathematics

Hasibuan, Saragih and Amry (2019) explained that one of the most significant roles of the MKO in teaching mathematics is to assist learners in developing problem-solving skills. Faulkner, Breen, Prendergast and Carr (2023) emphasised that problem-solving skills lead to a deeper understanding of mathematics. This is also supported by Cai and Hwang (2023) and Koichu (2020), who argued that using teaching approaches that learners are familiar with expands their understanding of mathematics through acquired problem-solving skills.

One of the approaches is play-based pedagogy, which is mentioned by Krath, Schürmann and Von Korflesch (2021). Play-based activities that learners are familiar with help expand their problem-solving skills in learning mathematics. Nur et al. (2020) found that play pedagogies that use ethnomathematics develop learners' problem-solving skills, critical thinking and learning of mathematical concepts. First, drawing from Nur et al. (2020), the researcher notes that the role of MKO is to use play-based pedagogy that integrates culture to extend problem-solving skills that are essential in learning mathematics.

Vygotsky's sociocultural theory confirms that effective learning occurs in a social setting and with an appreciation of culture (Vygotsky, 1978). Krath et al. (2021) asserted that play-based learning develops problem-solving skills in a social setting

by creating social interaction between the MKO and the learners. Ulandari, Amry and Saragih (2019) highlighted that a teacher's role is to provide a social setting for learners to develop the problem-solving skills required in mathematical teaching. Second, the researcher acknowledges that the MKO's role is to expose learners to play-based activities that may help develop mathematical problem-solving skills through social interaction.

Third, according to Ndlovu and Mncube (2021), the role of the MKO is to use principles of the ZPD through play-based activities to teach mathematical vocabulary and problem-solving skills. During assessments, the teacher can encourage learners to independently apply mathematical problem-solving skills by playing games (Ukobizaba, Nizeyimana & Mukuka, 2021). As such, the researcher views that the educator's role is to apply the principles of the ZPD by using Africanised play-based pedagogy to develop problem-solving skills that could help teach mental mathematics as it encourages incorporating culture, which happens in a social setting.

The study of Ling and Mahmud (2023) explored the challenges teachers experience in developing problem-solving skills to teach mathematics. Among other difficulties, integrating Information and Communications Technology (ICT) in teaching problem-solving skills was put forward (Ling & Mahmud, 2023). In the context of mathematics learning in South Africa, an MKO's role is to assist learners in developing problem-solving skills and using play-based pedagogy that appreciates African culture in online teaching (DBE; 2011). Consequently, this study aims to explore the use of Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners.

2.4 THE RELATIONSHIP BETWEEN THE THEORY OF ETHNOMATHEMATICS AND VYGOTSKY'S SOCIOCULTURAL THEORY

Figure 2.1 illustrates the relationship between the theory of ethnomathematics and Vygotsky's sociocultural theory and how they could be applied in the teaching of mental mathematics.

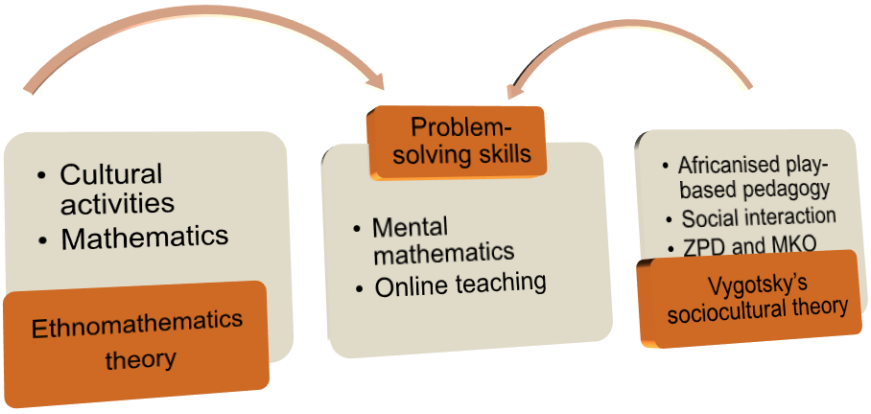


Figure 2.1 The relationship between the theory of ethnomathematics and Vygotsky's sociocultural theory

These two theories share a fundamental concept of problem-solving skills in the study's framework. This was clear when Acharya et al. (2021), Brandt and Chernoff (2015) and Rosa and Orey (2016) emphasised that the theory of ethnomathematics encourages the use of cultural activities in teaching mathematics as they develop problem-solving skills. Interestingly, for the evidence of this study, the researcher notes that Africanised play-based pedagogy could be used in teaching mental mathematics in the FP as it fosters learners' problem-solving skills (Moloi et al., 2021).

Vygotsky's theory focuses on how culture and social interaction may contribute to learners' mental development and problem-solving skills. The application of the ZPD and the role of the MKO were emphasised. The researcher remarks that Africanised play-based pedagogy could be used while using the principles of the ZPD to assist learners in developing their problem-solving abilities when learning mental mathematics. Furthermore, it was evident that the role of the MKO is to expose learners to Africanised play-based activities to promote problem-solving skills that are significant in learning mental mathematics. This study supports the claim that Africanised play-based pedagogy could be used in the online teaching of mental mathematics to FP learners, as it has been widely suggested that educators could enhance problem-solving skills through the use of Africanised play-based activities

that may foster social interaction (Mania & Alam, 2021). Therefore, problem-solving skills serve as the framework for this study.

2.5 CHAPTER SUMMARY

In this chapter, the theoretical framework underpinning this study was discussed. The theory of ethnomathematics and Vygotsky's sociocultural theory were reviewed in terms of using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. Most importantly, it was shown that African play-based activities could promote learner's problem-solving skills in mental mathematics. Since this chapter demonstrated the possibilities of using Africanised play-based pedagogy in online mental mathematics teaching, reviewing what other researchers have found on the same topic is necessary. Thus, the next chapter presents a literature review.

CHAPTER 3: LITERATURE REVIEW

3.1 INTRODUCTION

The preceding chapter discussed the theoretical framework underpinning this study. ethnomathematics and Vygotsky's sociocultural theories were applied to unpack the use of Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. Ethnomathematics theory argues about the significance of integrating culture in teaching mathematics. In contrast, Vygotsky's sociocultural theory assumes that educators (the 'MKO') could use the principles of the ZPD to assist learners in developing mental mathematical skills using Africanised play-based pedagogy. Furthermore, these theorists argue that Africanised play-based pedagogy could be used in online teaching. Another important concept from these theories is enhancing problem-solving skills that are relevant in teaching mental mathematics.

In this chapter, the researcher reviews the literature on using Africanised play-based pedagogy in the online teaching of mental Mathematics to FP learners. The literature review helps link the theories, policies, and practices in the education of FP learners (Magistretti, Ardito & Messeni Petruzzelli, 2021). This is corroborated by Bahishti (2021) and Mochkabadi and Volkmann (2020), who argued that the literature review assists the researchers in gaining an in-depth knowledge of the research problem and questions. The researcher agrees that the purpose of reviewing literature for this study is to understand the use of Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners.

The literature review makes relevant arguments on Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners and identifies research gaps. Section 1.5 explained that a traditional literature review was selected for this study. The selection of a conventional literature review confirms Li, Huang, Li, Liao, Chen, He, Yan and Gryllias's (2022) view that it frequently provides direction in choosing the best methodology for a study. Table 3.1 adapted from Miles (2017); illustrates the types of research gaps a literature review may reveal and could guide the selection of relevant research methodology.

Table 3.1: Research gaps that can be revealed in a literature review

Research gap type	Definition
Empirical	This dilemma relates to evaluating or empirically verifying study findings or propositions.
Evidence	Contradictions in the results of the earlier studies are a part of this gap. It happens when research findings support conclusions in and of themselves but contradict one another when viewed more broadly.
Knowledge	The knowledge gap is based on non-existent scientific findings.
Methodological	A methodological gap is the kind of gap that addresses the dispute that arises because the methodology influences study findings. This gap examines the issues with the research methodologies used in the earlier studies and presents a brand-new study direction that deviates from those methodologies.
Practical-knowledge conflict	Professional conduct or practices that differ from research findings or are not covered by research are called practical-knowledge conflicts of interest.
Population	There are always populations that are underserved and understudied.
Theoretical	The type of gap known as a theoretical gap deals with the discrepancies between theory and earlier research. For instance, an academic conflict might exist if different theoretical models are being used to describe the same occurrence, much like a methodological gap conflict.

Adapted from Miles (2017)

Table 3.1 shows different types of research gaps. For this study, the researcher narrows the discussion to the knowledge gap. The literature is then arranged according to themes that emerged from the research questions and the knowledge gap located. Khatib, Abdullah, Elamer and Hazaea (2022) argued that knowledge gaps must be connected to the theoretical framework. With this in mind, each theme generated as a knowledge gap was linked to the theoretical frameworks. As a result,

this chapter is outlined under five themes related to the study's research questions (Magistretti et al., 2021).

The chapter has five themes responding to the research questions. First is (3.2) Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners; (3.3.) addresses the role of play-based pedagogy in the online teaching of mental mathematics to FP learners; (3.4.) addresses the types of African play-based activities suitable for online teaching of mental mathematics to FP learners; (3.5.) addresses the legislative frameworks guiding teachers when using play-based pedagogy in the FP teaching; and (3.6.) looks at strategies used by teachers to support FP learners when using play-based pedagogy for mental mathematics teaching. The following section discusses the first theme, which is Africanised play-based pedagogy.

3.2 AFRICANISED PLAY-BASED PEDAGOGY IN THE ONLINE TEACHING OF MENTAL MATHEMATICS TO FOUNDATION PHASE LEARNERS

In this section, the researcher discusses the Africanised play-based pedagogy in the teaching and learning of mental mathematics. In this regard, it is crucial to review literature from studies conducted in different regions where their education system is similar to that of South Africa. Using culture and tradition in play-based pedagogy is believed to be significant in early childhood. Since Africanised play-based pedagogy is relevant to African countries, this study refers to studies that use play-based pedagogy that integrates cultural and traditional activities in teaching mathematics.

However, studies that use culture, tradition or Africanised play-based pedagogy in teaching mathematics are relatively scanty. The selection criteria for the literature review are shown in Figure 3.1.

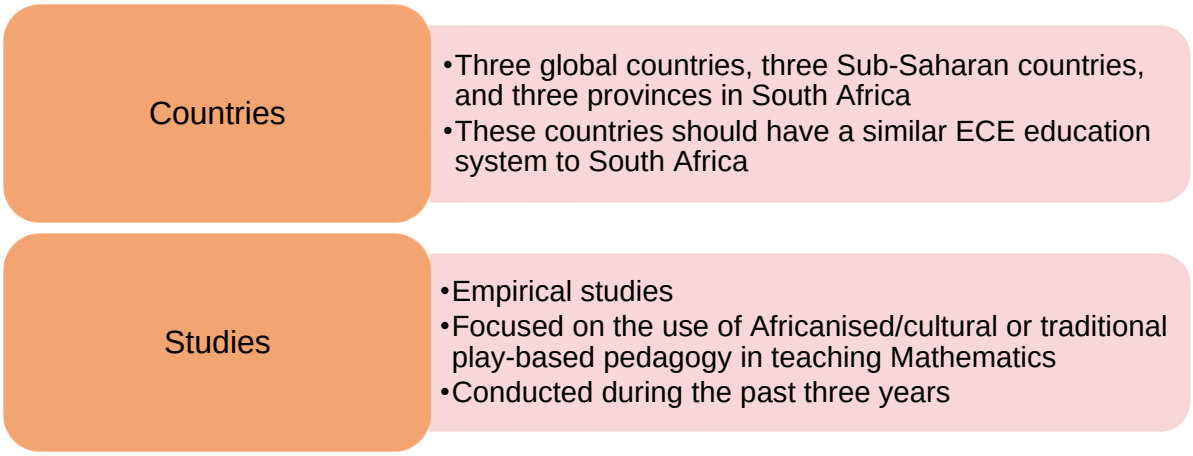


Figure 3.1: The criteria for the selection of countries and studies

The researcher discusses the Africanised play-based pedagogy in different countries in this section. The purpose of this section is to contextualise readers on current debates on Africanised play-based pedagogy to glean best practices that can influence the practice of teaching mental mathematics in the FP. The researcher knows that Africanised play-based pedagogy is mainly used in African countries. However, it does not deter one from tapping into best practices of play-based pedagogy outside the African continent. As such, the researcher discusses studies on play-based pedagogy from non-African countries such as Asia, Europe and North America. Furthermore, the researcher also evaluated research in countries such as Zimbabwe, Kenya and Nigeria. The researcher selected these countries based on the excellent reputation they have in using culture and play-based activities in the teaching and learning of mental.

3.2.1 Play-Based Pedagogy in Different Countries

Three studies from Asia, Europe and North America on using traditional play to teach learners mathematics are reviewed. Yang, Li and Ang (2021) focused on the similarities in the legislation of ECE from Asia, Europe, North America and South Africa in the use of play-based pedagogy. Bautista, Yu, Lee and Sun (2021) added that lately, there has been a strong push for adopting play-based pedagogy that integrates traditional culture in these regions when teaching young learners. More interestingly, Bautista et al. (2021) mentioned that ECE systems should use traditional games that involve digital technologies. So far, however, research has yet to pay attention to the use of games that integrate culture in the online teaching of mathematics.

3.2.1.1 Asia

In Indonesia, the use of cultural and traditional games in learning mathematics is encouraged in primary schools as Kamid, Sabil, Syafmen and Rohana's (2022) study accounts for the use of traditional Gundu (marbles) games in improving learners' discipline in learning mathematics. Their study used a comparative quantitative approach that used questionnaires and surveys to determine the relationship and influence between the character of discipline and student responses when using Gundu in mathematics. This study sampled 120 learners from three different elementary schools, who participated by responding to the integration of Gundu in mathematics (Kamid et al., 2022). Gazley and Guo (2020) are concerned that data collected from comparative quantitative research may limit the study's reliability as it favours many theories. Kamid et al.'s (2022) findings reveal a positive correlation as an increase in the use of Gundu games influences the learner's character in mathematics. Furthermore, they indicate that this game can be used to teach geometric concepts. Linking Kamid et al.'s (2022) findings on the theoretical framework underpinning this study, the integration of culture influences learners' characteristic of discipline in learning mathematics. As such, the researcher supports the idea that educators can apply the ZPD through games such as Gundu to teach mental mathematics.

3.2.1.2 Europe

Evans (2021) highlights that since early childhood in European countries promotes culturally sustainable classrooms, play-based pedagogy should be linked with cultural teachings in kindergartens. Björklund, van den Heuvel-Panhuizen and Kullberg (2020)and Faeh and Vogt (2021) emphasise that Switzerland is one of the countries that supports educators in using culture to teach mathematics in the early years. Fernández-Oliveras, Espigares-Gámez and Oliveras (2021) conducted a study in that country on implementing a playful microproject based on traditional games for working on mathematical and scientific content. Fieldnotes were collected from 32 learners through participant observation within a case study design in a qualitative setting (Fernández-Oliveras et al., 2021). Although participant observation may influence the bias of results, according to Morgan (2022), Fernández-Oliveras et al. (2021) demonstrated that learners' interaction with traditional games boost their mathematics

and scientific thinking. Making cross-references to the theoretical framework, Fernández-Oliveras et al.'s (2021) findings emphasise the importance of cultural and social interaction in teaching mathematics.

3.2.1.3 North America

The Yukon First Nation Education Directorate (YFNED) (2023) reports that the Yukon Department of Education (YDE) in North America encourages the use of indigenous culture and tools in teaching to develop young learners' mathematical skills. Eisazadeh, Rajendram, Portier and Peterson (2017) attested that indigenous games are supported in teaching mathematics in Canada.

Golafshani's (2023) study explored the use of indigenous storytelling in planning and teaching mathematical content in the northern region of Ontario, Canada. A phenomenological case study methodology was employed by Golafshani (2023) to view the experiences of 20 Grade 1 learners and two elementary teachers on implementing indigenous storytelling in the planning and teaching of mathematical content from public primary schools through record observations. Failing to select multiple elementary teachers from different schools may have limited the credibility of the study's findings. In response, Lemon and Hayes (2020) proposed that a triangulation method should be considered. Nonetheless, Golafshani (2023) found that indigenous storytelling helps children learn abstract mathematical concepts related to their own real-world experiences. Golafshani (2023) concluded that educators can use dice games to encourage interaction between learners in teaching mathematics content. Linking the findings of Golafshani (2023) with the theoretical framework of this study shows that Africanised play-based activities that use dice games could be used to teach mental mathematics as they promote social interaction and culture.

3.2.2 Africanised Play-Based Pedagogy in the African Context

Inyang (2022) highlighted that most African countries have formalised play-based activities incorporating African culture to teach learners. Maleq, Fuentes and Akkari (2022) also pointed to using African games in early childhood mathematics teaching in Sub-Saharan Africa. Guided by this, the researcher reviewed studies from Ghana, Nigeria and Zimbabwe.

3.2.2.1 Ghana

Nabie (2015) enlightens us that the inclusion of cultural games in teaching mathematics to young learners in Ghana is recommended by government legislation on ECE. Yekple, Vinyo and Kumah (2021)confirmed that play-based learning that includes indigenous knowledge can be used in teaching literacy and numeracy.

Tangkur, Nabie and Ali (2022) studied teachers' knowledge of indigenous games in teaching mathematics. Semi-structured interviews and an observation checklist within qualitative phenomenological research explored teachers' understanding of indigenous games in teaching mathematics (Tangkur et al., 2022). They collected field notes from five professionally trained mathematics teachers. They found that indigenous games motivate learners intrinsically and promote their interest in learning the subject. When relating the research findings of Tangkur et al. (2022) to the theoretical framework of this study, it is evident that Africanised play-based pedagogy plays a significant role in teaching mathematics.

3.2.2.2 Nigeria

Ogunyemi and Henning (2020) explain that most parts of Nigeria maintain that traditional play can be a teaching strategy in the early years. In the same breath, Dele-Ajayi, Strachan, Pickard and Sanderson (2019) asserted that digital games that infuse tradition could be used to teach learners mathematics in Nigerian classrooms.

The study by Oluwatayo, Anyikwa and Obidike (2020) set out to determine the challenges of a game-based learning strategy in teaching mathematics in Enugu State. They used questionnaires within the descriptive survey design in quantitative research to collect primary data from 200 primary school teachers. Considering the research instrument selected by Oluwatayo et al. (2020), Gibson and Bowling (2020) explained that it is difficult to conclude a study that only uses questionnaires as they limit participants' responses. Nonetheless, Oluwatayo et al. (2020) found that educators needed more time for game-based learning in teaching mathematics. They suggested that traditional games should be used in digital learning. According to Oluwatayo et al. (2020), there is a connection between this study's theoretical framework and adopting an Africanised play-based pedagogy in online mathematics

teaching. Based on this background, the researcher agrees that educators could employ digital games that feature African culture in the online teaching of mental mathematics.

3.2.2.3 Zimbabwe

Past research by Chikodzi and Nyota (2010) indicates that educators infuse cultural games to teach Shona learners mathematics. In addition to Chikodzi and Nyota (2010), Chikodzi (2022) also mentions that indigenous games, played mainly by the Shona people of Zimbabwe, promote participation in learning numeracy.

Sunzuma and Luneta's (2023) study was conducted in Zimbabwe based on implementing a learner-centred strategy in teaching mathematics. Using a case study research design, documents, interviews and lesson observation were used to collect rich field notes from four pre-service teachers. Their findings showed that learner-centred methods were used in group work and pairing sessions. Even with this, Sunzama and Lueta (2023) found that online mathematics teaching still needs to be improved. Although Sunzama and Luneta's (2023) findings may be interesting, it should be noted that the participants need to be more experienced in teaching mathematics. Considering this, the theoretical framework of this study and the findings of Sunzama and Lueta's (2023) study highlight the importance of teaching mathematics online.

3.2.3 Africanised Play-Based Pedagogy in South African Provinces

There needs to be empirical research on using Africanised play-based pedagogy in teaching mathematics from the Limpopo Province, where the researcher planned to gather field notes for this study. Therefore, the researcher selected the Free State, Kwa Zulu Natal, and Western Cape from the remaining eight (8) provinces.

3.2.3.1 Free State

The study ofMoloi, Mosia, Matabane and Sibaya (2021) explored the use of the skipping rope as an indigenous game to teach Grade 4 learners in Thabo Mofutsanyana District. They employed a qualitative case study using a participatory action research methodology. Field notes were collected from a total number of 47

participants constituted by 35 Grade 4 learners, one head of department, two Grade 4 Mathematics teachers, one Life Skills teacher, one mathematics subject advisor, four (*n*=4) parents, and three (*n*=3) members of the local royal family (Moloi et al., 2021). Their study found that skipping rope develops learners' problem-solving skills needed in mathematical word problems. Relating the findings of Moloi et al. (2021) to the theoretical framework underpinning this study, it is clear that the role of Africanised play-based pedagogy in teaching mathematics is to promote learners' problem-solving skills.

3.2.3.2 KwaZulu Natal

Hadebe-Ndlovu (2022) studied teachers' experiences incorporating indigenous games in the early years. Semi-structured interviews, semi-structured observations, and document analysis in a qualitative case study were employed to gather field notes (Hadebe-Ndlovu, 2022). Their participants were six FP teachers. The results from Hadebe-Ndlovu (2022)indicate that indigenous games boosted social interaction in mathematics classrooms. Moreover, using digital games that infused culture was encouraged in teaching mathematics (Hadebe-Ndlovu, 2022). The findings of Hadebe-Ndlovu (2022) align with the theoretical framework of this current study, as it promotes culture and socialisation in teaching mathematics. Against this backdrop, the researcher highlights the use of digital games that integrate culture into teaching mathematics.

3.2.3.3 Western Cape

Marange and Adendorff's (2021) study on using online mathematics games to teach algebra to Grade 8 learners was conducted in Cape Town. An interpretive case study design in qualitative research was employed (Marange & Adendorff, 2021). They collected field notes through lesson observations, questionnaires and semi-structured interviews to explore the contribution of online mathematics games to teaching algebra. The participants were 30 Grade 8 learners and one mathematics teacher. Marange and Adendorff (2021) found that online mathematical games improved learners' algebraic concepts. They further argued that teachers must support learners when playing online mathematics games to develop other mathematical concepts. Although Marange and Adendorff (2021) did not include culture, the lens of the theoretical framework shows that educators play a significant role through applying

the principles of the ZPD when teaching mathematics online. In light of this, the researcher concurs that educators such as MKOs must support and guide learners as they play games online to develop their mental mathematics skills and assist them in reaching their whole potential level of understanding. The next section examines the role that Africanised play-based pedagogy plays in the online teaching of mental mathematics

3.3 THE ROLE OF AFRICANISED PLAY-BASED PEDAGOGY IN THE ONLINE TEACHING OF MENTAL MATHEMATICS

Until recently, no previous research has explored Africanised play-based pedagogy in the online teaching of mental mathematics. As such, the researcher discusses the role of Africanised play-based pedagogy in teaching mental mathematics online.

The study by Dele-Ajayi et al. (2019) showed that the role of Africanised play-based pedagogy in online mathematics teaching is to improve learners' problem-solving skills. Educators were found to employ digital games incorporating cultural aspects to enhance problem-solving skills through participation, engagement and interaction in mathematics teaching (Dele-Ajayi et al., 2019). Russo, Bragg and Russo (2021) agreed with Dele-Ajayi et al. (2019) that playing digital games that infuse African culture helps to develop problem-solving skills needed for learning mathematics. Furthermore, Russo et al. (2021) mentioned that these educational games encourage social interaction in the mathematics classroom. Hwa (2018) explained that digital games can be a crucial educational tool for teaching mathematics by assisting learners in applying their understanding to solve problems in the world. The researcher, thus, concludes that the role of Africanised play-based pedagogy in teaching mathematics online is to develop learners' problem-solving skills through interaction fostered by digital games. In the context of this study, it shows that the role of Africanised play-based pedagogy in the online teaching of mathematics is related to the theoretical framework that underpins this study.

More research is needed about the role of Africanised play-based pedagogy in teaching mathematics online. To address this gap, the researcher decided it was appropriate to review the literature on the role of Africanised play-based pedagogy in teaching mathematics. Several previous researchers such as Chirinda (2021), Lunga et al. (2022), and Matsekoleng, Maile, Mashaba and Ntsana (2022) have reported that

the role of Africanised play-based pedagogy in teaching mathematics is to develop problem-solving skills. Chirinda (2021) indicates that using African play improves learners' problem-solving skills in mathematics. Lunga et al. (2022) added that play-based pedagogy integrating African culture supports learners' critical, creative, problem-solving, logical and analytical skills in mathematics. Masemola et al. (2022) added that during Africanised play-based learning, learners can solve complex mathematical problems.

Much literature has emphasised that indigenous games could be used in Africanised play-based pedagogy in teaching mathematics. The development of problem-solving skills has played a significant role in using indigenous games to teach mathematics. This statement is endorsed by several researchers, such as Akayuure and Ali (2016), Mosimege (2020), Tachie and Galawe (2021), Moloi et al. (2021) and Angkor et al. (2022) who noted that indigenous games develop problem-solving skills among learners. Similarly, Akayuure and Ali (2016), Mosimege (2020), and Tachie and Galawe (2021) concur that these games promote children's mathematical problem-solving abilities.

With this background in mind, the researcher maintains that Africanised play-based pedagogy could be used to promote learners' problem-solving skills in teaching mental mathematics. This is validated by Rosa and Orey (2016), who state that indigenous games can be used to develop mental mathematics, mathematics skills and problem-solving skills. On the one hand, Matsekoleng et al. (2022) argue that using African activities supports creative thinking and mathematical problem-solving skills. On the other hand, Hadebe-Ndlovu (2022) added that educators must use African play-based activities in online teaching to develop learners' high-level problem-solving through social interaction. As mentioned earlier, this aligns with the ontological and epistemological perspectives of the theoretical framework employed in this study. Learners' problem-solving skills could be promoted by using Africanised play-based activities that encourage social interaction in online teaching. The support of the MKO is also needed for learners to reach their complete understanding of mental mathematics on their own. The following section reviews the literature to identify suitable Africanised play-based activities that can be used online to teach mental mathematics.

3.4 TYPES OF AFRICAN PLAY-BASED ACTIVITIES SUITABLE FOR ONLINE TEACHING OF MENTAL MATHEMATICS TO FP LEARNERS

This study asks, '*What are suitable African play-based activities in the online teaching of mental mathematics to FP learners*?'. Kröger, Raschke, Campbell and Ullrich (2023) posited that, recently, digital technology has made it possible to play online. Interestingly, Oluwatayo et al. (2020) alerted us to the fact that Africanised games can be played online to teach mathematics. Studies by Dele-Ajayi et al. (2019) and Hadebe-Ndlovu (2022) supported the idea that digital games incorporating culture should be promoted in mathematics lessons in South Africa. In addition, Dele-Ajayi et al. (2019) further highlighted that educators who support learners when playing digital games that infuse culture when teaching mathematics, problem-solving skills and social interaction are stimulated. In this context, the researcher discusses digital African games such as Morabaraba, Ludo and Math Zap Cards.

3.4.1 Morabaraba

So far, the Morabaraba game has been used in face-to-face teaching and learning activities when delivering mental mathematics to learners. However, little attention has been paid to using this African game in digital teaching and learning despite its availability. Dochshanov and Tramonti (2022) clarified that this game can be played online or downloaded using Android or iPhone Operating System software when teaching mathematics to young learners. This implies that Morabaraba can be used in the online teaching and learning of mental mathematics for FP learners.

Livingstone and Wallis (2019) enlighten us that Morabaraba is a two or more-player board game with African influences. As such, the researcher views this game as a multiplayer online game. Mosimege (2020) indicated that the board is made up of three square segments (outside, middle, and inner) that are each divided into 20 equal parts by four straight lines. Moreover, each player needs 12 tokens, each of which is a different colour from the opponent's pieces. These tokens are called cows (Mosimege, 2020).

Figure 3.2: A Morabaraba board

Source: Decor Essentials (2024)

Similarly, Tachie and Galawe (2021) asserted that the game has three phases: placing, moving and flying the cows[3]. Nkongolo (2023) attested that the game can be won in two ways; for instance, a player cannot move a cow or when only two remain. Additionally, the game ends in a draw. If neither player can shoot one of their opponent's cows in 10 turns and both players have just three remaining cows, then it is a draw (Nkongolo, 2023).

Based on the instructions of this game, the researcher learned that it develops learners' mathematical skills. Before the game, Mosimege (2020) and Tachie and Galawe (2021) explained that learners develop counting skills when they add their cows. Problem-solving skills are developed when learners strategise, from being blocked to moving their cows during the game. Even though Abdullah (2022) did not show the integration of Morabaraba with mathematics, the development of cognitive

[3] "The term flying cows usually describes a strategic move in which a player lines up three pairs of two stones in a row, enabling them to fly one of their stones to any vacant intersection on the board . The player can quickly create a mill (three stones in a row) in another position using this move, which increases the player's power and may even allow them to capture an opponent's stone. The move is called flying cows because it mimics the quick movement of an object across the board and comes from the game's cultural roots, where the stones are sometimes referred to as cows (Nkongolo, 2023).

skills was emphasised. In light of this view, and based on the theoretical framework of this study, we can postulate that the cultural principles and rules embedded in the Morabaraba game could be used to develop learners' cognitive skills that are significant in mental mathematics in the FP.

Moloi (2014) added that the first phase of the game teaches probability in mathematics. In comparison, the second stage assists learners in understanding ascending or descending patterns when moving the cow (Tachie & Galawe, 2021). Matsekoleng et al. (2023) also supported Tachie and Galawe (2021) that when learners move their cows on the board, they learn 2D shapes. Lastly, Shu and Liu (2019) mentioned that Morabaraba teaches learners problem-solving skills when a player flies over their opponent's cows. In line with the theoretical framework in this study, it should be noted that Morabaraba can be used to teach mental mathematics in the FP.

Abdullah (2022) stated that educators can share their computer screens when using Morabaraba online so learners can play in pairs. Drawing from Abdullah (2022), the role of the MKO is to support learners when playing Morabaraba using online teaching platforms to deliver mathematics lessons. Matsekoleng et al. (2024) agreed that online social interaction and collaboration are stimulated when learners play in pairs. Although Kusmaryono et al. (2021) did not focus on Morabaraba or online teaching, the researcher agrees that educators can use the principles of the ZPD to help learners develop problem-solving skills in an online gaming environment. Since learners in rural schools have network connectivity challenges, the researcher suggests that these games should be downloaded on learners' or parents' computers, tablets or tablets.

3.4.2 Ludo

The selection of Ludo for this study is based on Ulhusna, Putri and Zakirman's (2020) research findings. A questionnaire within a quasi-experimental research design was used to collect data from 22 Grade 3 learners in Nan Sabaris who were registered for the 2018 to 2019 academic year (Ulhusna et al., 2020). Their study found that using the Ludo game digitally boosted learners' interest and enthusiasm in mathematics. The researcher was prompted to use Ulhusna et al.'s (2020) results to see how this game can be used in the online teaching of mental mathematics to FP learners.

Bhatia, Lakra, Anand and Eden (2021) highlighted that a traditional game called Ludo has recently become popular on digital platforms. Figure 3.3 illustrates a Ludo board:

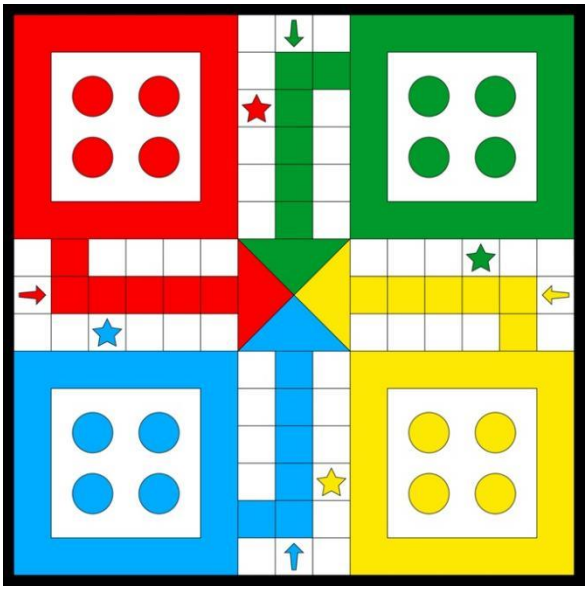


Figure 3.3: Demonstration of Ludo board game

Source: Shutterstock

Bhatia et al. (2021) described Ludo as a board game that has four “yards” or “home bases,” which are squares with the colours red, green, blue and yellow at their corners. Tansley (2022) explains that the centre of the cross is a “finish triangle,” which is a square with four triangles, one for each of the four colours. Furthermore, there are four “safe squares” on the track as well, which are separated from one another around the circuit and marked with a distinct colour or symbol (Bhatia et al., 2021).

Han and Zhou (2022) asserted that this game is played by two to four players at a time, while each participant is given one of the four colours and a token that matches their home base’s colour. Bhatia et al. (2021) argued that the player who rolls the highest number on the dice will start the game by placing a token in the home base. They also mention that the player must roll a six to move a token from the home base to the game track. A token must complete one track lap before entering the finish triangle’s home stretch and corresponding colour. The turn is lost if no legal move can be made, given the number on the dice (Bhatia et al., 2021). A player’s token is returned to the home base if placed in a square already occupied by another player’s token. Additionally, whoever places a token inside the finished triangle first wins the

game (Bhatia et al., 2021). The game may stop when one player wins, or it may continue to rank the remaining participants, depending on how many players are left.

It is widely held that Ludo teaches learners mathematical concepts. This was validated by Chanana, Shukla and Rao (2022), who showed that when learners move tokens along the board, they learn concepts embedded in mathematics. Kobandaha, Tonra and Anam (2022) confirm that the home base and finish triangle teach learners space and shapes. Pradhan (2019) observes that when learners move tokens, they develop mathematical ideas to win the game. In a similar view, Drešar (2020) and Lembrér (2020) agree that counting skills are developed when learners sum up the number of dots on the dice and move their tokens. Drešar (2020) added that the dots arranged in patterns on the dice teach patterns and subitising[4] skills. Sumadi, Kusmayadi and Fitriana (2022) posited that playing Ludo online enhances learners' mathematical problem-solving skills. Lehocká, Betak, Žitný, and Szabó (2021) agreed that it teaches problem-solving skills in geometry. Integrating this background with the theoretical framework, the researcher believes that all these mathematical skills learned by playing the Ludo game online could be applied in teaching mental mathematics.

3.4.3 Math Zap card

The study of Singh, Hoon, Nasir, Ramly, Rasid and Meng (2021) investigated the efficacy of the Math Zap card game in teaching mental computation. They used a mixed-method approach using an experimental and descriptive design that was taken and tested amongst 34 primary school learners aged 12 to 13 from five classes from a public school in a district in Selangor, Malaysia. Primary data/field notes were collected through mental computation tests and questionnaires to assess the effectiveness of the card game in developing skills (Singh et al., 2021). Their study found that the Math Zap card game is a highly effective learning tool as it boosts learners' numeracy computation skills such as fractions, percentages and decimals. Even though the Math Zap card game is used in online teaching, it should be noted that no researcher has attempted to explore this game in teaching mental mathematics to FP learners.

[4] When subitising, one can quickly determine the number of small groups of objects without counting them (Duran & Bostan, 2023)—for example, the number of dots on a dice.

Despite this, Singh et al. (2021) advocated for the use of Math Zap card games as an intervention strategy to teach kindergarten learners mathematics through online teaching. They explain that Math Zap can be played by two to six players. To play this game, Singh et al. (2021) mentioned that a dealer should ensure that each player has an equal number of cards. They also advised that no player can look at any participants' decks. As such, the cards must be flipped while facing down.

Furthermore, Singh et al. (2021) continued that the first player is seated on the dealer's right side and begins by placing a card face up in the centre of the table. Cards are continuously added to the top until a match or pair is found to create a pile in the centre. The pile is awarded to the first player to place his hands on it while yelling "Zap." However, the player's turn is lost, and a penalty is assessed when they incorrectly exclaim "Zap" during their turn. The winner is the first person to collect all of the cards. A draw occurs when a pair or match is found after a cycle of successively piling up cards to create a pile in the middle has been completed, for example, 3 and 3, 2 and 1 + ½ + ½ (Singh et al., 2021).

The Math Zap game aims to develop learners' matching skills, increase their concentration span and increase their mental skills (Singh et al., 2021). Notably, against those mentioned earlier, the researcher views the Math Zap game as relevant in the online teaching of mental mathematics to FP learners. It teaches learners mathematical concepts such as the relationship between fractions, decimals, percentages, and Roman numerals (Singh et al., 2021). Rasid, Nasir, Singh, Han and Sueb (2022) affirmed that playing this game with learners is an excellent opportunity for teachers to talk to them about number relationships, and social interaction is developed in that way. It is against Rasid et al.'s (2022) suggestion that the researcher agrees that educators (MKO) could apply the principles of the ZPD by asking learners questions about the number of relationships for learners to reach their capability level. The following section discusses the legislative frameworks governing Africanised play-based pedagogy. Pyle, DeLuca, Wickstrom and Danniels (2022) emphasised using different African play-based activities; curriculum policies in teaching mathematics should guide educators.

3.5 LEGISLATIVE FRAMEWORKS GUIDING THE USE OF AFRICANISED PLAY-BASED PEDAGOGY IN THE FOUNDATION PHASE TEACHING

It was found by Mukhamedov, Khodjamkulov, Shofkorov and Makhmudov (2020) that for the successful implementation of curriculum, there are legislative frameworks that educators must follow in teaching and learning. In this section, the researcher compares legislative frameworks of various Ministries of Education from around the world including South Africa on using Africanised play-based pedagogy to teach mathematics.

3.5.1 Legislative Frameworks from Around the World

Evidence from Kay (2022) suggests that the legislative framework plays a role in pedagogical practice in teaching mathematical skills in childhood education. Looking at various legislative frameworks, there is a consistency in infusing cultural activities with play-based pedagogy in mathematics teaching. The United Nations Children's Fund (UNICEF) (2022) established that educators need to include cultural contexts in play-based pedagogy. Noticeable similarities are from the *"Te Whāriki"* framework in New Zealand, which emphasises and acknowledges sociocultural perspectives in play-based learning of languages and mathematics (Westbrook & Hunkin, 2020). England's Early Years Foundation Stage (EYFS) also maintains that differentiated learning and cultural activities can be integrated with play-based learning (Corral-Granados et al., 2023). A South African framework concurs that play-based activities that include historical culture develop learners' numeracy skills (DBE,2021).

Noticeable differences are demonstrated by Nicholson (2022) in that Denmark's ECEC system emphasises the socio-pedagogic tradition and a child-centred approach without emphasising a single philosophical approach. Ball, Brammer, and Tayler (2023) assert that these strategies are still limited.

3.5.2 Legislative Framework from South Africa

The DBE (2018) initiated the idea that play-based pedagogy needs to be used in all subjects, including mathematics, in the FP. The policy further acknowledges the integration of indigenous knowledge. In addition, the lack of ECD and FP teachers' guidelines on integrating play-based pedagogy with cultural activities could affect

learners' performance in mathematics and languages (DBE, 2018). The DBE states that the purpose of the Annual Teaching Plan (ATP) is to provide a trimmed curriculum through virtual/online teaching and mathematics learning in the FP (DBE, 2021). Guided by Chirinda, Ndlovu and Spangenberg (2021), Chirinda, (2021) and Bose and Seetso (2016), the researcher agrees that play-based activities that infuse historical knowledge could be used in the online teaching of mathematics to FP learners. In the same view, a legislative framework should guide educators in using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners.

3.6 STRATEGIES USED BY TEACHERS TO SUPPORT FP LEARNERS WHEN USING PLAY-BASED PEDAGOGY FOR MENTAL MATHEMATICS TEACHING

Bala Wande is an ongoing strategy that the DBE established to support educators using play pedagogies in teaching mathematics. It has been implemented only in the Eastern Cape, Kwa Zulu Natal, Limpopo and Mpumalanga Provinces. Mpofu, Issac, Ndamase, Sonjica and Sapire (2021) agreed that this strategy has been implemented to create and test materials for teaching mathematics in the FP. However, very few play-based activities are included in mental mathematics. Even though they are limited, Meiring (2021) mentioned that they promote high-level problem-solving skills applicable to mental mathematics.

Although there is much previous literature about play-based pedagogy, only some studies have focused on its use in mental mathematics, and more research on mathematics needs to be done. As a result, the researcher reviews recent studies on play-based pedagogy in different countries to see strategies to support educators.

Pyle et al. (2022) studied integrating classroom assessment with play-based learning for kindergarten teachers in Ontario, Canada. Eisazadeh et al. (2017) and Pyle et al. (2022) show that education in Canada is similar to that of South Africa because children aged three to six years old enrol in kindergarten programmes engage in play-based learning. The study by Pyle et al. (2022) used a two-phase qualitative research approach. Primary data/field notes were collected through extensive classroom observation and semi-structured and video elicitation interviews from 18 kindergarten classrooms. It was found that teachers fit into one of three play profiles that align with play-based assessment: informal, formal, or hybrid (Pyle et al., 2022). In addition, Pyle

et al. (2022) explained that play-based learning policies could be used to integrate assessments. Besides that, Pyle et al. (2022) used two phases of qualitative research. However, Kaimara, Oikonomou, and Deliyannis (2022) asserted that primary data collected from children might not be authentic because they have different cognitive levels. Although Pyle et al. (2022) did not apply play-based learning in teaching mathematics, it is worth noting that integrating play in assessments could be used as a strategy to develop learners' mathematical skills.

A study on the conceptualisation and implementation of play-based curriculum and pedagogy was conducted in the Oromia region of Ethiopia by Geletu (2023). ECE in Ethiopia is similar to South Africa's and is driven by a play-based pedagogy (Abebe & Keery, 2023). Geletu (2023) used a concurrent triangulation design within a mixed research approach. Primary data was collected through questionnaires, interviews, focus group discussions, and document examination (Geletu, 2023). It was found that ECE curricula lacked individuality, ages, stages, cultural context and child-relevance that are developmentally appropriate (Geletu, 2023). Therefore, Geletu (2023) suggested that teachers could use systematic scaffolding to accommodate different learners to ensure quality instruction in play-based pedagogy. Besides the fact that a concurrent triangulation design is used to support, cross-validate or bolster research findings, Jackson, Mohr and Kindahl (2021) mentioned that the research design employed by Geletu (2023) may generate biased findings. Interestingly, regarding incorporating Africanisation, Geletu (2023) mentioned using cultural context in play-based pedagogy, and how it could enhance learners' holistic development still needs to be improved. Against Geletu's (2023) findings, the researcher believes that play-based activities that infuse developmentally appropriate practices could be a strategy for educators to deliver quality teaching and learning activities in childhood education.

The study by Lunga et al. (2022) demonstrated the use of play-based pedagogy in young children. Their study was conducted in Gauteng, South Africa. They used a qualitative research approach within participatory action learning and action research design to interrogate the enhancement of play-based pedagogy. Primary data was gathered through meeting transcriptions and photovoice from action learning sets (workshop). The participants were one Grade R teacher, two practitioners, one Grade R facilitator, and three Northwest researchers (Lunga et al., 2022). It was found that parents and teachers should collaborate to maximise the use of a play-based

pedagogy in both social and learning environments. Lunga et al. (2020) used action research even though Pereira-Moliner and Molina-Azorín (2023) remarked that this design lacks repeatability and rigour. What is not clear from the study of Lunga et al. (2020) is the use of play-based pedagogy in teaching mathematics. Nevertheless, Lunga et al.'s (2020) findings indicate that a strategy that could be used to infuse play-based pedagogy in teaching FP learners is to encourage collaboration between parents and learners. While there is no reliable evidence on strategies that could assist FP teachers in using Africanised play-based pedagogy, the studies reviewed above provide how some strategies can be infused into online teaching.

3.6.1 Enhancement of Problem-Solving Skills

Meiring (2021) asserted that play-based activities that allow manipulation of mathematical resources could be used to develop learners' problem-solving skills in teaching mental mathematics. Research findings by Dele-Ajayi et al. (2019) 's study also point toward using digital games in teaching mathematics to improve learners' problem-solving skills. It is noteworthy to consider the perspective presented by Dai, Ke, Pan and Liu (2023) regarding the use of digital games, complete with resources, rules and instructions, in mathematics education to foster learners' cognitive abilities and problem-solving skills. Additionally, in line with Mbhiza's (2021) emphasis on the efficacy of Africanised games like Morabaraba and Ludo, the researcher concurs that these games hold potential for enhancing problem-solving skills.

3.6.2 Inclusion of Assessment

Africanised play-based activities that could be used in the online teaching of mental mathematics should include learners' assessment activities. This is verified by Pyle et al. (2022), who stated that a legislative framework that guides educators in using Africanised play-based activities could also guide assessment. Since mental mathematics activities use informal activities in the FP, the DBE (2011) shows that informal assessments guide formal assessment activities (i.e., ongoing assessments) in the FP. Mental mathematical assessment plays a significant role in achieving learners' mathematics performance in this stage.

3.6.3 Developmentally Appropriate Practice

According to Geletu (2023), Africanised play-based activities could be used to develop holistic development in young children. Hayashi, Liew, Aguilar, Nyanamba and Zhao (2022) concur that Africanised play-based activities could be a developmentally appropriate practice. Brottman, Char, Hattori, Heeb and Taff (2020) explained that online games that integrate culture address inclusivity. Initially, games were known to develop fine and motor skills in the FP; now, it is known that online games can accommodate learners in wheelchairs to participate fully. This is supported by Jost, Cobb and Hämmerle (2019), who stated that even physically challenged learners can play online games to learn mental mathematics.

3.6.4 Collaboration Between Stakeholders and Teachers

Lunga et al. (2020) encouraged MKOs to be part of play-based pedagogy. Even though Lunga et al. (2020) did not mention Africanised play-based activities or online teaching, Dong, Cao and Li (2020) explained the role of parents and teachers in using Africanised play-based activities. Parents must monitor their children's devices (Bhattacharya et al., 2019). Against this background, the researcher understands that parental involvement in using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners is crucial.

3.7 CHAPTER SUMMARY

The literature relating to the use of Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners is provided in this chapter. The literature was reviewed through the lens of the theoretical framework underpinning the study. Thus, educators could use Africanised play-based pedagogy to use digital games that integrate culture as they learn problem-solving skills essential in teaching mental mathematics. The research methodology selected for this study is discussed in the next chapter.

CHAPTER 4: RESEARCH METHODOLOGY

4.1 INTRODUCTION

Chapter 3 reviewed the literature on using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. The literature review showed that Africanised play-based pedagogy develops learners' problem-solving skills in the online teaching of mental mathematics. The researcher familiarised herself with relevant literature and identified gaps. This chapter used the appropriate research methodology aligning with the study's theoretical framework to address the gaps. The link further enlightens the selection of research design to explore the use of Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners and discuss participants' selections, data collection tools, data analysis, trustworthiness and ethical measures.

Drawing from the definition of the research methodology in Section 1.6, it assists in employing relevant methods to solve educational problems by answering formulated research questions guided by the problem statement. The researcher used the methodology outlined in Figure 4.1 to explore using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners (Muzari et al., 2022). Bhangu, Provost and Caduff (2023) agreed that a researcher needs to follow a systematic procedure from selecting a research paradigm to data analysis. Figure 4.1 illustrates the chosen research methodology of this study. The figure also presents the relationship between research paradigm, approach, design, data collection instruments and analysis.

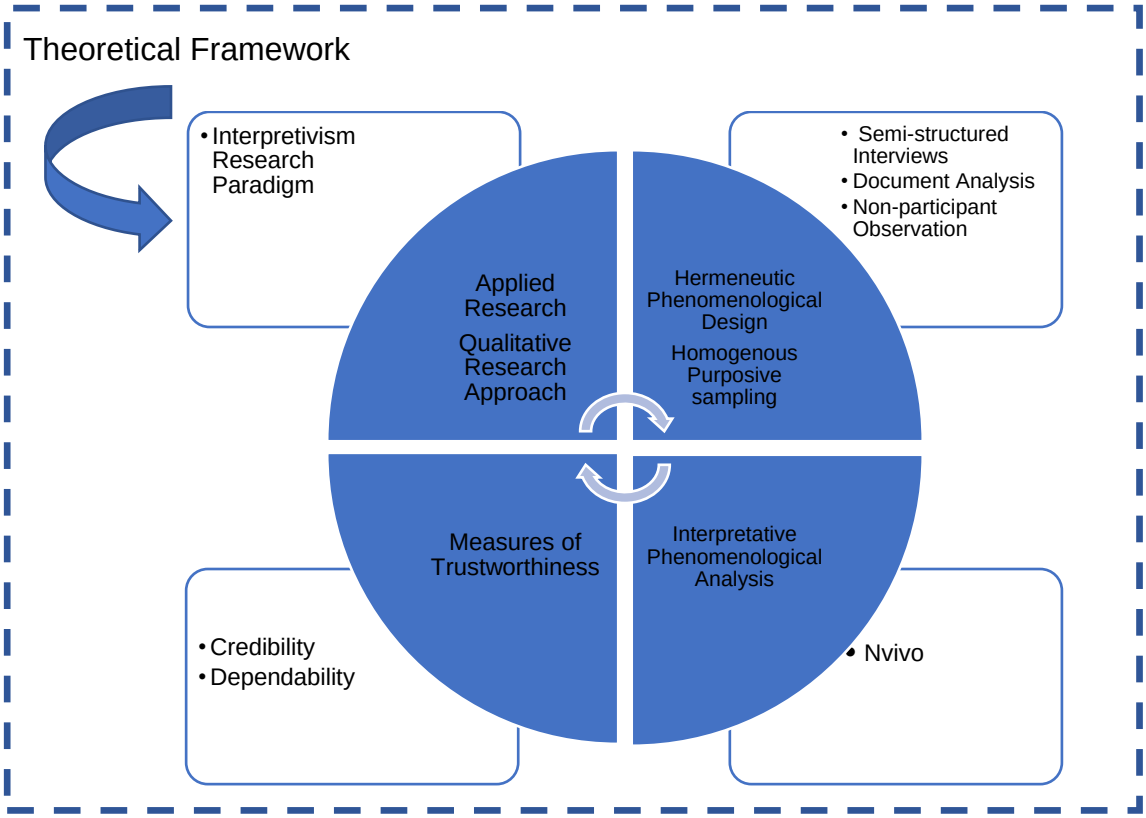


Figure 4.1: Outline of research methodology chapter

Figure 4.1 paints the relationship between the theoretical framework and the research paradigm. It shows that the researcher will use homogenous purposive sampling to recruit participants. Furthermore, the researcher collected the data through semi-structured interviews and non-participant observations and later analysed it through interpretive phenomenology to explore the use of Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. The research paradigm used for this study is discussed in the next section.

4.2 RESEARCH PARADIGM

A research paradigm is defined in Section 1.6.1 of this study as a pattern that influences the researcher to a worldview concerning what has been studied. Mensah et al. (2020) agreed that a researcher can identify and construct their worldview through the selected research paradigm. Similarly, Kaushik and Walsh (2019) assert that the philosophical ideas within a chosen research paradigm guide the researcher in interpreting data. For this study, the interpretivist paradigm was chosen. The interpretivism research paradigm was used in this study because it aligns with the

theoretical framework of this study. This paradigm is used by researchers who interpret their world and believe in multiple truths and subjectivity, as indicated in Section 1.6.1. For this study, it is selected based on its philosophical assumptions. Panya and Nyarwath (2022) asserted that the interpretivist paradigm assumes that reality is a subject, and multiple realities are constructed socially. As such, humans construct knowledge from their experiences shaped by their history, cultural and social perspectives (Moisander, Närvänen & Valtonen, 2020).

Against this backdrop, the researcher views the interpretivist paradigm as being linked to the theoretical framework of this study. Ethnomathematics theory argues that mathematical knowledge is constructed through cultural and social constructions. Vygotsky's sociocultural theory assumes that when learners engage in play-based activities incorporating culture, social interaction is stimulated and mathematical knowledge is acquired. The link corroborates that using Africanised play-based pedagogy in online teaching can influence learners' understanding of mental mathematics. The interpretivist paradigm affected the researcher's views on using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners (Pervin & Mokhtar, 2022). This context demonstrates that no other paradigm can relate to the theoretical framework of this study.

Mooney (2022) underpinned the philosophical assumptions of research concerning the interpretivist paradigm in this study. It is believed that the construction of human knowledge is significantly influenced by relativist ontology and subjective epistemology (Mooney, 2022), and hermeneutic methodology. Ontology, epistemology and methods within the interpretivist research paradigm are discussed in the next section.

4.2.1 Relativist Ontology

From Mooney's (2022) perspective, reality is indirectly constructed based on individual interpretation. Sanchez, Bonache, Paz-Aparicio and Oberty (2023) stated that understanding a participant's reality is fundamental in interpretivist research studies. In addition, Junjie and Yingxin (2022) agreed that an individual's reality is subjective, multiple, socially constructed and cannot be generalised. Siddiqui (2019) explains that ontological interpretivism paradigms are usually shared between individuals and cultures. The researcher understands that social and cultural integration affects

participants' reality. The research findings gathered through the interpretivist paradigm cannot be generalised as their reality is subjective.

4.2.2 Subjective Epistemology

Epistemologically speaking, researchers interpret gathered data through their own viewpoint. The researcher constructs knowledge socially from personal experiences and interactions with participants. Dangal and Joshi (2020) and Burns, Bally, Burles, Holtslander and Peacock (2022) affirmed that the interpretivist paradigm provides a lens through which knowledge is subjectively gained through personal experiences influenced by historical or social perspectives. Similarly, Pilarska (2021) mentioned that subjectivist knowledge is both culturally and historically situated. Thus, the participants' personal experiences affect how they construct knowledge. Subjective epistemology influences hermeneutic methodology which is discussed in the next section.

4.2.3 Hermeneutic Methodology

The choice of hermeneutic methodology is significantly shaped by the interpretivist paradigm. Hermeneutic methodology is an approach to research that focuses on interpretation and understanding, particularly in fields such as philosophy, theology, literature and social sciences. In research, hermeneutic methodology emphasises the importance of interpreting and understanding the context, cultural factors and subjective perspectives that influence human behaviour.

Thus, the researcher used this methodology to select participants, data collection tools, and data analysis strategies relevant to this study to answer the research question (Muzari, Shava & Shonhiwa, 2022). Following Kivunja and Kuyini (2017), the researcher used the hermeneutic methodology to interact with participants through conversation, dialogue, questions, listening, reading and writing to understand their lived experiences on the study phenomenon.

This study explored the use of Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. This was guided by Pilarska (2021), who pointed out that researchers in the interpretivist tradition are directed to explore the phenomenon of participants' lived experiences that are influenced by hermeneutic methodology.

4.2.4 A Balanced Axiology

A balanced axiology is assumed in the interpretivist research paradigm as it advocates for respecting participants' values and rights and producing authentic findings. Kivunja and Kuyini (2017) confirmed that a balanced axiology assumes the researcher should have a positive attitude toward participants to present a balanced report of the study's findings. Because of Kivunja and Kuyini's (2017) view, this study included measures of trustworthiness and ethical considerations.

The link between these assumptions is significant since the study's research questions, participants' selection, data collection tools and processes, and data analysis are all impacted by the methodological implications of the interpretive paradigm. The choice of the interpretivist paradigm implies a near certainty about selecting a research approach. It is worth noting that assumptions of hermeneutic methodology guided the appropriate research approach discussed in the next section. Guided by an interpretive paradigm, the selected research type is discussed in the next section.

4.3 RESEARCH TYPE

Section 1.6.2 explained that research types are classified according to their objectives. A chosen research type informs the selection of the research approach. As indicated in Section 1.6.1, this study used applied research because of its objective to formulate either a framework model, strategies or guidelines that are based on the theoretical framework. As such, this study suggests strategies that could assist educators in using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners in Section 6.7. This is supported by Pandey and Pandey (2021), who state that applied research aims to develop creative solutions that can be implemented in a specific pedagogical approach to address the problem under study. The following section discusses the research approach for this study.

4.4 RESEARCH APPROACH

It was indicated in Section 1.6.2 that a research approach is a plan and procedure that the researcher selects based on the problem statement and chosen paradigm that helps with data collection, analysis and interpretation. Because the interpretivist

paradigm uses a hermeneutic methodology, it requires qualitative data (Al-Ababneh, 2020b). In Section 1.6.2, the qualitative approach was selected. One of the most important reasons, which was not emphasised in Section 1.6.2, is that the qualitative research approach values social truth that is embedded in social surroundings (Nigar; 2020). In contrast to a quantitative or mixed-method approach, a qualitative research approach aligns well with the interpretivist research paradigm.

Considering the aim of this study, to explore the use of Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners, selecting a qualitative research approach adds significant value to this study since this phenomenon is a social issue. Therefore, it was suitable for this study to collect qualitative data to provide details and an in-depth understanding of using Africanised play-based pedagogy and its implications, which quantitative or mixed-method approaches do not offer.

In the same vein, Dawadi, Shrestha and Giri (2021) confirm that researchers who aim to explore issues in social settings employ a qualitative research approach that assists in collecting in-depth data. They added that this helps in understanding the study's research problem better. Rashid, Rashid, Warraich, Sabir and Waseem (2019) attest that for a better understanding of the study's research problem, the researcher needs to gather individuals' perspectives and experiences on the phenomenon in-depth because reality is multiple. As such, like other research approaches, there are various research designs in a qualitative approach to guide the researcher with appropriate research procedures. The research design using a qualitative approach is discussed in the next section.

4.5 RESEARCH DESIGN

In Section 1.6.3, the research design was described as a strategy whereby a researcher selects relevant methods to answer the research questions and address the problem of the study. This definition aligns with Islam and Aldaihani's (2022) view that a research design in qualitative research is used to answer "how" and "what" questions to understand the phenomenon being investigated. As mentioned in 1.6.3, hermeneutic phenomenology was selected to elucidate and interpret participants' lived experiences to obtain an in-depth and rich understanding of the phenomenon under study (Dangal & Joshi, 2022). In this thesis, hermeneutic phenomenology will be used

to explore participants' lived experiences. The main reason for selecting hermeneutic phenomenology was to understand how Africanised play-based pedagogy can be used in the online teaching of mental mathematics to FP learners. The researcher collected participants' lived experiences and interpreted them to answer the study's research questions (mentioned in Section 1.3.1).

Tomaszewski, Zaretsky and González (2020) explained that researchers must use phenomenology research design to understand participants' lived experiences and the meaning of their experiences. In the same way, Van Manen (2016) explained that researchers who selected a qualitative research approach could use hermeneutic phenomenological research design as it is associated with interpreting reality. Consequently, this study is grounded by Van Manen's (2016) hermeneutic phenomenology. It also backs up Mooney's assumptions on the interpretivism research paradigm. Brooks (2021) agrees with its relevance to the interpretivist research paradigm that researchers who use this design acquire rich, in-depth data. Dodgson (2023) states that it explores lived experiences of the participants and interprets them. Similarly, Becker and Schad (2022) posited that, in educational studies, researchers use this design to develop a deep understanding of teachers' lived experiences of a specific phenomenon.

In this study, hermeneutic phenomenology refers to the process of gathering the lived experiences of participants and being able to interpret them. This is adapted from Nigar (2020) that hermeneutic phenomenology is the study of lived experiences and their interpretation through text. Hermeneutics is from the Ancient Greek verb "*hermeneueuein*," meaning 'to translate or interpret' (Farrell,2020), phenomenology is a process of understanding a phenomenon(Dangal & Joshi, 2020). Thus, when read together, hermeneutic phenomenology is concerned with interpreting a phenomenon. It is against those above that hermeneutic phenomenology is suitable for this study, unlike transcendental and existential phenomenology.

A double hermeneutic process was used in this study. The research participants made sense of their lived experiences, and the researcher will further interpret those experiences (Dodgson, 2023). This simply indicates that one of the roles of a researcher in hermeneutic phenomenology is to analyse participants' lived experiences. To produce credible findings, the researcher's lived experiences on using

Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners were discussed (Folgueiras Bertomeu & Sandin Esteban, 2023). In the same breath, Dörfler and Stierand (2021) discuss a need to include self-reflexivity in hermeneutic phenomenology, whereby a researcher discusses participants' lived experiences on the phenomenon under study. As a result, the following section discusses the researcher's lived experiences using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners as self-reflexivity.

4.5.1 The Researcher's Lived Experiences on the Phenomenon Under the Study

Both the researcher's professional and academic experiences have had an impact on her interest in the phenomenon. First, the interest in using "play-based pedagogy" started when she taught mathematics as a FP educator. Because FP learners learn through playing, the researcher found play-based pedagogy an interesting teaching strategy. This pedagogy is also encouraged by the recent curriculum implemented in the FP (DBE, 2011b, 2018). This pedagogy is typically used to increase learners' holistic development and mathematical skills.

Second, from the researcher's master's degree research, it was found that play-based pedagogy is employed to assist learners in building their social skills, which are essential for developing number sense skills. The study further concluded that educators can use indigenous games to teach FP number sense. This strengthened the idea of using Africanisation in play-based pedagogy in the FP, particularly while studying mental mathematics.

Finally, COVID-19 influenced the use of online teaching even in the FP. Using online teaching has always been a struggle, especially in rural schools. However, the researcher believes African play-based activities could also be incorporated into the online teaching of mental mathematics in the FP.

Acknowledging the researcher's lived experiences of the study's phenomenon links to the philosophical orientation underpinning this study. As a result, the researcher was willing to accept all ideas emerging from participants' lived experiences and interpret them through the lens of the theoretical framework and reviewed literature. Against this background, both the theoretical framework and reviewed literature support the notion that using Africanised play-based pedagogy in online teaching develops

learners' problem-solving skills, which are fundamental in learning mental mathematics (discussed in Chapters 2 and 3).

Self-reflexivity assisted in producing credible results. As a result, the researcher consistently interpreted the participants' lived experiences of the phenomenon. She allowed emerging lived experiences from the participants and interpreted them through the theoretical framework of this study. As Dangal and Joshi (2020)advised, researchers in hermeneutic phenomenology require a hermeneutic cycle to understand their data. Thus, the hermeneutic cycle is discussed in the next section.

4.5.2 Hermeneutic Cycle

A hermeneutic cycle was used to explore the use of Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners by interpreting their lived experiences through the theoretical framework and literature review. This is supported by Dangal and Joshi (2020) and Nigar (2020), that hermeneutic cycle is used in hermeneutic phenomenology to understand a phenomenon through interpretation of the lived experiences of participants to improve consistency and dependability of the findings. Figure 4.2 below illustrates the hermeneutic cycle within this study.

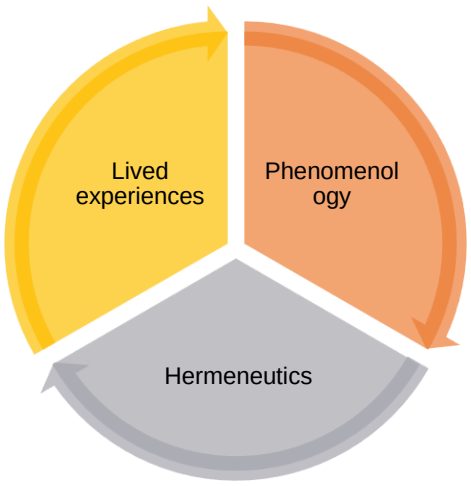


Figure 4.2: Illustration of hermeneutic cycle used to explore the phenomenon under the study

- Lived experiences: using semi-structured interviews, document analysis and non-participant observations.

- Phenomenology: explored the use of Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners.
- Hermeneutics: Interpreted lived experiences through the lens of theoretical framework (ethnomathematics and Vygotsky's sociocultural theories) and the reviewed literature.

Figure 4.2 shows that the researcher interpreted the lived experience of educators through the lens of the theoretical framework and reviewed literature: hermeneutic phenomenology guided selection of the participants (sampling), data collection instruments and data analysis. The following section discusses how participants were chosen.

4.6 POPULATION AND SAMPLING

4.6.1 Population

Section 1.6.4.1 of this study defined a population as a group of participants that suits the study. Carter, Shih, Williams, Degeling and Mooney-Somers (2021) supported the idea that a research population is a group of individuals that matches the study's demographic details. Thus, the researcher needs to sample relevant participants from the study population. For this study, the researcher used an accessible population because of reasonable access to FP educators teaching mathematics in the Capricorn South district, Limpopo (South Africa) (Roberts, Pavlakis, & Richards, 2021). It was mentioned in Section 1.6.3 that a total estimation of three hundred FP educators is a population for this study. This is based on a total analysis of fifty-six schools in the Capricorn South district. Because hermeneutic phenomenology aimed to explore participants' lived experiences on the use of Africanised play-based pedagogy in the online teaching of mental mathematics, there was a need to sample relevant participants for this study to realise this aim.

4.6.2 Sampling

Section 1.6.4.2 explained that sampling is a strategy that a researcher uses to select participants centred on specific criteria to gather in-depth data. Löhr, Weinhardt and Sieber (2020) also asserted that sampling is a process of selecting participants from the population using certain criteria to collect in-depth data insight on specific research issues. As indicated in Section 1.6.4.2, a homogenous purposive sampling strategy was used to select participants for this study to understand their lived experience using

Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. As such, participants were selected based on a degree of homogeneity of their lived experiences on the phenomenon under study. This is guided by Muzari et al. (2022) and Subedi (2021), who stated that in hermeneutic phenomenology, researchers select their participants through homogenous purposive sampling to gather rich, in-depth and thick descriptions of their lived experiences of the phenomenon.

Muzari et al. (2022) advised selecting a small sample because the researcher elicits rich data. Therefore, 12 educators with lived experiences in using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners participated in this study. Three educators (Grades 1–3) each from four Limpopo Province primary schools comprised twelve participants. The language used by teachers and learners is Sepedi.

Guided by Pryce-Miller, Bliss, Airey, Garvey and Pennington (2023), individuals with lived experiences in teaching mathematics in the FP were selected to participate in this study. As such, FP educators teaching mathematics fall within the population in this study. Since this study used hermeneutic phenomenology, it was fundamental to select participants who have similar lived experiences of the phenomenon being studied (Jedličková, Müller, Halová & Cserge, 2022). Lesko, Fox and Edwards (2022) agreed with Jedličková et al. (2022) that participants should be selected based on similar experiences to produce authentic findings.

When selecting participants, the certainty that educators have similar lived experiences and in-depth knowledge of using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners was considered. The minimum criteria for selecting these educators was their willingness to share their lived experiences to produce valid findings. This is supported by Veesart and Cannon (2022), who stated that there should be a benchmark to select participants from the population. Following Lindner and Schwab (2020), educators were sampled through the inclusion and exclusion criteria listed in Table 4.1.

Table 4.1: The inclusion and exclusion criteria

Criteria	Inclusion	Exclusion
Willingness to participate in a study (Robinson, Rosenzweig, Moss, & Litman, 2019)	Able to participate and willing to give informed consent.	Participants that are not willing to share their lived experiences.
Demographic characteristics		
Ethnicity	Individuals who consider themselves African	Individuals who consider themselves as non-African
Geographic characteristics		
Qualifications	Individuals with at least a minimum teaching qualification	Individuals without a minimum teaching qualification (unqualified to teach)
Professional experience	Educators who worked in the FP teaching mathematics with at least three years of experience	Educators who worked in a different phase than the FP taught mathematics. Educators who worked in the FP teaching mathematics with less than three years of experience
Lived experiences on the phenomenon under the study		
Knowledge of using play-based pedagogy	Educators who can use play-based pedagogy in teaching mathematics to FP learners	Educators who do not know how to use play-based pedagogy in teaching mathematics
Knowledge of integrating African play-based activities in teaching mathematics	1. Educators who can integrate African play-based activities to develop learners' mathematical skills. 2. Educators who know about African play-based activities that could be used to develop learners' holistic development will be included.	Educators who do not know African play-based activities, including games, songs, and rhymes, in teaching mathematics.
Knowledge of using online teaching in the FP	1. Educators who can teach FP learners through online platforms.	Educators who are not interested in using online teaching in the FP.

Criteria	Inclusion	Exclusion
	2. Educators who can use online teaching platforms but whose schools do not make provision for that will be considered.	

Educators who met the inclusion criteria (the second column in Table 4.1 above) were selected, and in line with Meyer and Mayrhofer (2022), the researcher requested the educators to fill in the inclusion and exclusion criteria. Those who met the requirements were invited to participate in the study.

Contrary to other non-probability sampling techniques, homogeneous sampling is the most appropriate for this study as it directs the collection of rich and in-depth data on participants' actual experiences (Subedi, 2021), and it is linked with the philosophical orientations underpinning this study (Dibley, Dickerson, Duffy & Vandermause, 2020). The procedure for gathering data is outlined in the next section.

4.7 DATA COLLECTION AND METHODS

Section 1.6.5.1 clarified that the purpose of data collection tools is to collect data from the participants to answer the study research questions. Guided by hermeneutic phenomenology, semi-structured interviews, document analysis and non-participant observations were used to elicit rich, in-depth, detailed, and first-account lived experiences of educators on the use of Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners (Fuster Guillen; 2019; Toivonen, Charalambous & Suhonen; 2023).

The definitions of each tool are described in Section 1.6.5. Semi-structured interviews were used to solicit the lived experiences of using Africanised play-based pedagogy in the online teaching of mental mathematics. Document analysis was used to corroborate educators' responses from the interviews to see how they plan their lessons to integrate Africanised play-based pedagogy and its contribution to learners' achievement. Non-participant observations were used to triangulate data from semi-structured interviews and documents to verify the consistency between planned lessons and classroom implementation. Through observations, the researcher explored the development of problem-solving skills using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. The method by which each data collection tool was used in this study is explained below.

4.7.1 Semi-Structured Interviews

Section 1.6.5.1 noted that in semi-structured interviews, participants are engaged in a discussion while being asked questions about the phenomenon. Husband (2020)

explains that during semi-structured interviews, the researcher engages with the participants in a conversation about their lived experiences that aligns with the study's research questions. Semi-structured interviews were used to solicit the lived experiences of educators on the use of Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. The semi-structured interviews were chosen because they allow probing questions to engage educators in a conversation and establish rapport with the teachers. This is understood by Lauterbach (2018), who agreed that in hermeneutic phenomenology, the interview aims to develop a rich understanding of the phenomenon and create a conversation on how they interpret the meaning of their experiences. Thomas (2021) notes that probing questions in semi-structured interviews draw participants' underlying experiences, perceptions and views of the phenomenon. Open-ended questions were used to motivate a spontaneous conversation concerning each educator's experiences of the phenomenon.

Before commencing with interviews, the researcher requested educators' consent to participate in the study. Twelve educators were interviewed one-on-one through face-to-face sessions. The researcher obtained educators' consent to record the sessions to capture the conversation between the researcher and educators. Coleman (2022) and Sharma (2017) agreed that recording an interview is encouraged in qualitative research as it creates validity, reliability and credible findings. Since Hwang, Kirkham, Marshall, Kharrufa and Olivier (2023) agreed that participants should revisit their experiences during the interviews, the researcher divided the semi-structured interviews into three sections. This is explained in detail in Section 4.7.1.2.

4.7.1.2 Designing of the interview schedule

The semi-structured interview schedule is consistent with the study's research questions and hermeneutic phenomenology. Semi-structured interviews were designed to solicit educators' lived experiences and views on using Africanised play-based pedagogy in teaching mental mathematics to FP learners online. Semi-structured interviews were divided into three sections (see Appendix H), Section 1 was used to obtain the participants' history and context of their lived experiences. Both closed-ended and open-ended questions were used. Section 2 used open-ended questions to assist educators in reconstructing their experiences of the phenomenon.

Lastly, Section 3 was divided into two parts (Section 3A and 3B). Section 3A used think-aloud interviews, while Section 3B stimulated recall interviews (Malva, Leijen & Arcidiacono, 2023) to assist in reflecting on the meaning of experiences in the phenomenon.

4.7.1.2.1 Section 1: History and context

To obtain educators' background on using Africanised play-based pedagogy, the first section of interviews asked educators about their lived experiences. Since homogenous purposive sampling is used to sample participants based on their lived experiences of the phenomenon, participants were asked about their professional and academic experience in teaching mathematics in the FP and their ethnicity (to obtain cultural background). This section had five questions to obtain data on educators' demographic, geographic and historical context of the phenomenon under study.

4.7.1.2.2 Section 2: Reconstruction of experiences

The research questions in Section 1.3.1 informed the formulation of interview questions to solicit their lived experiences and on using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners (Adeoye-Olatunde & Olenik, 2021). This section had 11 open-ended questions on educators' lived experiences.

4.7.1.2.3 Section 3: Reflection on the meaning of experiences

Section 3 aimed to assist educators in reflecting on their experiences. Hermeneutic phenomenology requires reflecting on participants' lived experiences, which informed the last section of this study's interviews through think-aloud (Section 3A) and stimulated recall questions (Section 3B) (Keightley, Croydon & Madden, 2023). Integrating think-aloud questions helped educators provide accurate information, while stimulated questions supported them in revisiting their experiences.

- Section 3A: Think-aloud interview format

Only Grade 3 educators from four public primary schools participated in Sections 3A and 3B. During the think-aloud interview, the researcher requested educators to think

about a lesson on using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners in their heads. Then, after ten minutes, she requested that educators verbally express their thoughts as they mentally prepared the lesson. The researcher asked the educators four clarifying questions regarding the planned lesson. Afterward, the researcher requested them to formally schedule the lessons they learned through non-participant observations to see how they implemented the lesson they were thinking about before the stimulated recall section of the interview.

- Section 3B: Stimulated recall interview format

The researcher met with educators for the stimulated recall interview session a day after the lesson was presented. The researcher requested that educators reflect on their experiences teaching mathematics to FP learners. The researcher asked educators four open-ended questions related to the study's research questions. Additionally, they were requested to explain activities that assisted learners to develop problem-solving skills. Document analysis is discussed in the next section.

4.7.2 Document Analysis

As indicated in Section 1.6.5.2, document analysis used in scrutinising documents requested from the participants (Kayesa & Shung-King. 2021). Document analysis was used to corroborate educators' interview responses and see how they planned their lessons to integrate Africanised play-based pedagogy and its contribution to learners' achievement. Because the documents usually requested from the participants in hermeneutic phenomenology are personal documents (Carnevale, 2020), the researcher asked for educators' copies of lesson plans and learners' activity books.

4.7.2.1 Lesson plans

Using the hermeneutic cycle illustrated in Figure 4.2, the researcher interpreted how the educators planned their mathematics activities. During the think-aloud interviews, the researchers asked educators about the legislative framework that guides their lesson planning. The researcher also analysed the lesson plans to describe the legislative frameworks that guided educators in creating their lessons. The researcher

further compared what the educators said during think-aloud sessions and how they formally plan their lesson plans. Lesson plans were only required from four educators teaching Grade 3.

4.7.2.2 Learners' activity books

The researcher asked for their parents' permission before requesting learners' activity books. Consent letters were sent to the parents through the educators. The researcher requested that learners sign assent forms upon their parents' permission. A sample of the learners' assent form is attached in Appendix G. The researcher requested copies of three activity books from educators. The researcher interpreted the assessment activities their educator gave the learners to see the relationship between learners' activity from the lesson plan and what was in their books. The researcher used the learners' grades to verify the activity's success. Furthermore, the assessment activities that educators used in Africanised play-based activities were compared with the pedagogies that educators used before engaging in the study.

4.7.2.3 Formulating and utilising document analysis tool

The document analysis tool was designed to analyse lesson plans and activity books. In the first column, the researcher created nine questions that aligned with the study's research questions. The researcher analysed lesson plans and learners' activities by responding to the questions in the second column of the data analysis tool. The following section discusses non-participants' observations.

4.7.3 Observations

As mentioned in Section 1.6.5.3, observation is a process of seeing and hearing what participants are doing in their settings. Frechette, Bitzas, Aubry, Kilpatrick and Lavoie-Tremblay (2020) explained that during observations, the researcher's role is to capture what they see or hear when participants are implementing their daily activities. Non-participant observation was used for this study, and the reasons for selecting this type are well explained. However, what should have been mentioned is that it is used to avoid conflict of interest (Sreeram, Cross & Townsin, 2023). Non-participant observation is a technique of seeing and hearing participants doing their daily activities without interacting with them (Oppong Frimpong, 2021). Section 1.6.5.3 revealed that a non-participant observation would be used to corroborate data from semi-structured

interviews. This is where the researcher explored the life experiences of educators on the use of Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. As such, the researcher collected the data independently to be as close as possible to the FP learners. There was direct contact with the life experiences of educators while observing participants to understand the significance of one's life experience. This is encouraged by Muzari et al. (2022) who stated that in hermeneutical research, close observation should be used to collect data from participants to explore the life experiences of participants on a particular phenomenon.

Against this backdrop, the researcher observed educators independently to get close to them and gather rich, in-depth data. Notably, this contributed to the researcher's subjective interpretations. This is supported by Khoa, Hung and Hejsalem-Brahmi (2023) and Klinke and Fernandez (2023), that observations in qualitative research allow the researcher to understand the pedagogy under study better.

Epistemologically, Köhler, Rumyantseva and Welch (2023) posited that the characteristics and importance of a phenomenon are explored in non-participant observations, and they are based on the researcher's subjective interpretation of what they witnessed. Similarly, Khoa et al. (2023) and Yoon and Uliassi (2022) agreed that as observations depend on the researcher's interpretations, it is a subjective approach to information collecting. By understanding the scholars above, the interpretations of data in this study are influenced by the theoretical framework and literature review. Thus, the researcher observed how problem-solving skills are developed using Africanised play-based pedagogy in the online teaching of mental mathematics.

Data from semi-structured interviews were corroborated with non-participant observation data. Non-participant observations were used to validate educators' responses from semi-structured interviews and assist them in revisiting their lived experiences (Toivonen et al., 2023). As mentioned before, the researcher requested educators to think aloud about their lessons in using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners in think-aloud interview sessions. The researcher observed the educators implementing the lessons to their learners during the mathematics periods.

Notably, the researcher observed how problem-solving skills were developed using Africanised play-based pedagogy in the online teaching of mental mathematics. The

researcher met with educators a day after lesson observation to commence stimulated recall interviews (Section 3). The researcher requested educators to identify moments in the lesson that demonstrated the development of problem-solving skills. The researcher further asked them to elaborate on what legislative framework was used to guide them in using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. The researcher also pointed to the moments in their experiences she identified before the stimulated recall interviews. The researcher contextualised educators' reflections and experiences within their play-based pedagogy by asking them to reflect on their teaching practices.

4.7.3.1 Designing of non-participants observation checklist

Non-participant observation was designed to explore suitable African play-based activities and their role in the online teaching of mental mathematics to FP learners. Additionally, the enhancement of problem-solving skills was observed. In the first column, the researcher used the study's research objectives to create criteria that the researcher observed. The researcher observed how problem-solving skills are developed guided by the theoretical framework and literature review under research objective 1: *to understand the role of Africanised play-based in the online teaching of mental mathematics to FP learners*. Digital games that integrate African culture in the online teaching of mental mathematics to FP learners were also observed.

4.7.3.2 Utilisation of non-participants observation checklist

There are three columns on the observation checklist. Questions in line with the research questions for the study are in the first column. The second column has yes and no answers in response. Commentary is placed in the final column.

Only three educators were observed using the checklist, which was used to mark off each element. The researcher used prolonged engagement during the interview, which helped to obtain rich, thick and in-depth data. The data collected from non-participant observation assisted educators in revisiting their lived experiences in a stimulated recall interview format. Non-participant observations promote rigorous research in hermeneutic phenomenology when integrated with semi-structured interviews (Prosek & Gibson, 2021). How the obtained data was analysed and interpreted is explained in Chapter 5.

4.8 MEASURES OF TRUSTWORTHINESS

Measures of trustworthiness are described in Section 1.7 as a degree of confidence in data, interpretation and methods used to ensure the quality of a study. Lemon and Hayes (2020) agreed that to ensure that the study is high quality, the researcher must fulfil several requirements. This is included because the interpretivist paradigm strongly focuses on a balanced axiology (Kivunja & Kuyini, 2017). Since this study used a hermeneutic phenomenology, the researcher integrated credibility and transferability to confirm the trustworthiness of the findings through the lens of qualitative research (Dabengwa, Raju & Matingwina, 2020). The following section explores how credibility was applied in this study.

4.8.1 Credibility

The researcher used prolonged engagement, reflexivity, triangulation, peer and participant debriefing and member checking to test the findings and interpretations with the participants. Since this study employed a hermeneutic phenomenology design, the truth of how educators know and experience the use of Africanised play-based pedagogy in the online teaching of mental mathematics to the FP established credible results. Credibility measures how true-to-life a qualitative study is or how accurate and reliable its conclusions are (Lemon & Hayes, 2020).

4.8.1.1 Prolonged engagement

The researcher used multiple-interview formats within semi-structured interviews to elicit detailed, rich and in-depth data on the lived experiences of educators on the phenomenon. This resulted in prolonged engagement with participants during data collection. The researcher ensured that in-depth experiences of the life experiences of educators through non-participant observation were obtained. This was done to establish prolonged engagement.

4.8.1.2 Reflexivity

Reflexivity increases internal validity in hermeneutic phenomenology approaches. The researcher discusses her role (reflexivity) in Section 4.5.1 by using bracketing to avoid being biased in the interpretation of data. Reflexivity captured the essence of the phenomenon as experienced by participants. During data analysis, the reflexivity

notes were imported into the NVivo software as part of the memoing process to ensure that the researcher reflected on her experiences and analysed the data from the theoretical framework and the reviewed literature.

4.8.1.3 Triangulation

Triangulation in hermeneutic phenomenology research improves the validity and credibility of the research findings (Dangal & Joshi, 2020). Riazi, Rezvani and Ghanbar (2023) stated the possibility of applying data, investigator, theory and methodological triangulations within a qualitative research approach. As a result, different methods of triangulation, including method, data and theory, were applied in this study.

4.8.1.3.1 Methodological triangulation

Collecting educators' lived experiences on the study's phenomenon through semi-structured interviews, document analysis and non-participant observations increased the credibility of the results (Striepe, 2021). Dangal and Joshi (2020) maintain that the corroboration of data gathered through multiple data collection tools decreases the insufficiencies and biases rather than using one method.

4.8.1.3.2 Data triangulation

Because data triangulation focuses on more than two rounds of data analysis to reduce the risk of false interpretations, the researcher manually coded data from three data sets using the keywords from the study's research questions. Secondly, the same data was co-coded using NVivo software. Finally, the researcher's supervisor assisted in re-coding the data through NVivo. The data from non-participant observations was triangulated with the data from semi-structured interviews and documents to ensure the consistency results on educators' lived experiences in using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners.

4.8.1.3.3 Theory triangulation

The components of ethnomathematics theory and Vygotsky's sociocultural theory were used to formulate the categories in Section 5.3.1, which helped interpret data. This was guided by Dangal and Joshi (2020) who stated that several theories consider a subject or phenomenon from several angles, with various lenses and with multiple questions in mind.

4.8.1.4 Peer debriefing

The researcher collaborated with a colleague knowledgeable about qualitative research and had unbiased opinions about the study to review the researcher's notes, final report and general methodology (Sabnis & Wolgemuth, 2023). A colleague does not have experience teaching in the FP or conducting research in ECE. This assisted in credibility because the peer provided valid feedback.

4.8.1.4 Member checking

After the observations, the researcher assisted educators in reflecting by revisiting their experiences. This assisted the participants in checking whether their life experiences corroborated the first session of semi-structured interviews. After transcribing the data obtained through semi-structured interviews into text, the researcher sent each participant their data set to verify the accuracy and clarify their lived experiences (Dangal & Joshi, 2020). The study's dependability is discussed in the following section.

4.8.2 Dependability

Internal validity and an inquiry audit based on qualitative research were used in this study (Nassaji, 2020). This was motivated by Hasan, Rana, Chowdhury, Dola and Rony (2021) who stated that the validity of the study findings is referred to as dependability when discussing consistency and reliability.

4.8.2.1 Internal validity

Semi-structured interviews were recorded to increase internal validity in this study. The researcher used audio recordings to capture interviews to reduce internal bias (Stenfors, Kajamaa & Bennett, 2020). Additionally, data from semi-structured interviews were corroborated with the data from lesson plans and learners' activity books.

4.8.2.2 Inquiry audit

The researcher requested the supervisor to co-code the data during analysis to confirm the accuracy of the findings for this study. This assisted in finding consistency

in the development of codes (Linneberg & Korsgaard, 2019; Sileyew, 2019). The following section focuses on ethical issues.

4.9 ETHICAL CONSIDERATIONS

Section 1.8 clarified that ethical considerations are the researcher's guidelines to ensure ethical standards are applied throughout the research study. Suri (2020) maintained that ethical consideration in research aims to maximise the benefits of participating in a survey and minimise negative impacts on all the stakeholders. Under a qualitative research approach, the researcher must protect participants at all levels by considering all possible risks in a hermeneutic phenomenology study. Every study that involves human participants should adhere to the protection of human subjects (Wang, Wu, He, Li & Wang; 2023). This is also encouraged by a balanced axiology within interpretive research. Guided by Wang et al. (2023), the researcher considered all possible risks that could affect educators not only during the collection of data but even in the presentation of findings.

4.9.1 Ethical Clearance Certificate and Permission Letters

Before data collection, the researcher obtained ethical clearance at the UNISA (Ethics Committee Review). A copy of the ethical clearance is attached as Appendix A. A requisition letter and ethical clearance certificate were used to request permission to conduct research from the DBE (through the LPDE). The permission to conduct research from LPDE and the ethics certificate from Limpopo Research Ethics are attached in Appendix B and Appendix C, respectively. Upon receiving these documents from the department, requisitions to conduct research at schools were sent to four principals to allow the educators to participate. A copy of the permission letter from School 2 is attached as Appendix D. After the principals' permission letters were received, letters were also sent to twelve educators to request their participation. The research aim and study area were made very clear in the letter. The researcher followed all the guidelines and observed the risks provided in terms of the ethical clearance, especially because FP learners were involved. The participant educators were sent consent letters.

4.9.2 Informed Consent

All potential educators (participants) were given informed consent with full disclosure of the aim, participation benefits, possible risks and funding behind the study. Each participant was advised of their rights and responsibilities and will be assured they can withdraw from participating in the study without penalties. Since the study is hermeneutic phenomenology, the responses could be verbal and non-verbal during semi-structured interviews. As such, they were allowed to refuse to answer uncomfortable questions, or they had the right to withdraw a specific response.

The researcher closely monitored how the interviews or observations affected the educators because of existential issues in hermeneutic research. To explain informed consent and provide them a chance to ask questions, the researcher visited educators at their school (Lobe, Morgan & Hoffman, 2020). The researcher clarified that participation is entirely voluntary and that they will not suffer any consequences if they choose not to participate or withdraw from the study. She explained to educators how data will be gathered through semi-structured interviews, document analysis and non-participant observation (Ruslin, Mashuri, Rasak, Alhabsyi, & Syam, 2022). She went into further detail about the stimulated recall and think-aloud interview sessions and how data will be used. Educators who chose to stay involved in the study were asked to sign their consent forms; a sample of consent forms from the educators and parents are attached in Appendix F and G, respectively.

4.9.3 Anonymity and Confidentiality

The researcher withheld the names or other identifying information of participants during the collection of data, analysis and interpretation of findings to protect their anonymity and confidentiality. As such, pseudonyms were used throughout data collection and the study's conceptualisation. Mufalo, Muleya and Simui (2022) recommend giving participants pseudonyms in the presentation and discussion of findings to maximise anonymity and confidentiality. As such, the researcher used pseudonyms in this study; refer to Section 5.1.1, which explains how participants were given pseudonyms.

4.9.4 Data Protection

The data from three data sets will be kept in software with encrypted passwords for at least five years, and hardcopies will be locked in a cabinet for five years. Audio data from semi-structured interviews will also be stored on a computer protected by a password (McMullin, 2023).

4.10 CHAPTER SUMMARY

This chapter outlined that hermeneutic phenomenology with a qualitative research approach would be used to explore Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. Guided by hermeneutic phenomenology, the researcher elicited educators' lived experiences on the phenomenon through semi-structured interviews and non-participant observations. The researcher adhered to all recommendations for ethical conduct made by the University of South Africa's ethical committee. Furthermore, NVivo software analysed the data through an interpretive phenomenology strategy. The data analysis and interpretations of the study's findings are discussed in the next chapter.

CHAPTER 5: DATA ANALYSIS AND INTERPRETATIONS

5.1 INTRODUCTION

The previous chapter focused on research methodology. A hermeneutic phenomenology research design within a qualitative approach was employed to ensure the study's research questions were answered. Data gathered through semi-structured interviews, document analysis and non-participant observation from twelve FP educators in Capricorn South District, Limpopo, was analysed using interpretative phenomenological data analysis. The first section of this chapter describes data preparation using each data collection instrument. The next section of the chapter describes the data analysis using the NVivo 14. Finally, the results are discussed based on the themes aligned with the lens of the theoretical framework and reviewed literature. The study was underpinned by the primary research question:

How can Africanised play-based pedagogy be used in the online teaching of mental mathematics to FP learners?

Research sub-questions

- What role does Africanised play-based pedagogy play in the online teaching of mental mathematics to FP learners?
- What are suitable African play-based activities in the online teaching of mental mathematics to FP learners?
- What legislative frameworks guide teachers using Africanised play-based pedagogy in the FP?
- What strategies do educators use to support learners using Africanised play-based pedagogy in teaching mental mathematics to FP learners?

5.1.1 Description Details of Participants

Three FP educators (teaching Grades 1, 2 and 3) each from four public primary schools in Capricorn South District participated in the study. Twelve educators were involved in semi-structured interviews; and among the 12, four Grade 3 educators further supplied their teaching and learning documents, such as lesson plans and learners' activity books, which were subjected to document analysis. The four educators also participated in observations. All educators who participated in this

study were given pseudonyms to ensure their anonymity and confidentiality (Lahman et al., 2023). The schools were named and ranked according to the chronological order of visits: Schools 1 to 4. The same order was applied to educators' names as shown in Table 5.1. The participant biographies are shown in Table 5.1.

Table 5.1: Biographies of participants

Pseudouyms of the participants	Ethnicity	Teaching experience in years	Highest qualification	Grade	Gender
S1FPE1	African	3	Bachelor of Education in Foundation Phase	1	Female
S1FPE2	African	24	Advanced Diploma in Education	2	Female
S1FPE3	African	8	Bachelor of Education in Senior Phase	3	Female
S2FPE1	African	22	Bachelor of Arts	1	Female
S2FPE2	African	29	Ace in Foundation Phase	2	Female
S2FPE3	African	15	Honours Bachelor of Education in Educational Management	3	Female
S3FPE1	African	7	Bachelor of Education in Foundation Phase	1	Female
S3FPE2	African	8	Advanced Diploma in Education	2	Female
S3FPE3	African	3	Bachelor of Education in Foundation Phase	3	Male
S4FPE1	African	8	Honours Bachelor of Education in Policy and Law Management	1	Female
S4FPE2	African	6	Bachelor of Education in Foundation Phase	2	Female
S4FPE3	African	8	Bachelor of Education in Senior Phase and Further Training	3	Female

Given the biographies of the educators from Table 5.1, it is clear that they have a generally good education background and enough teaching experiences in the FP, which contributed significantly to the use of Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. The following section describes the research site, which is Capricorn South District.

5.1.2 Geographic Details of Research Site (Capricorn South District)

All four primary schools are in Capricorn South District in Limpopo Province, South Africa. This district's name is derived from the Tropic of Capricorn, which is its geographic latitude (Khudzadzo, Ndwambi, Edward, Alfred, Mpandelid, Van Niekerke & Petjaf; 2021). They are all under the Mankweng cluster and Polokwane municipality. Two schools (S3 and S4) were based in the Mankweng township. The other two schools were in rural areas (S1 and S2). As a living showcase of the African culture of the region, all these schools are situated in tribal council areas. The tribal council leaders instil cultural identity and pride. More interestingly, among other projects, the Capricorn South District participated in initiatives run by the Department of Sports, Arts and Culture, including the district schools' sports tournaments, district junior Dipapadi and district indigenous games. Schools 2, 3 and 4 were close to each other, while S1

was far from them. All these schools had high enrolment numbers. Figure 5.2 provides a map of the research sites.

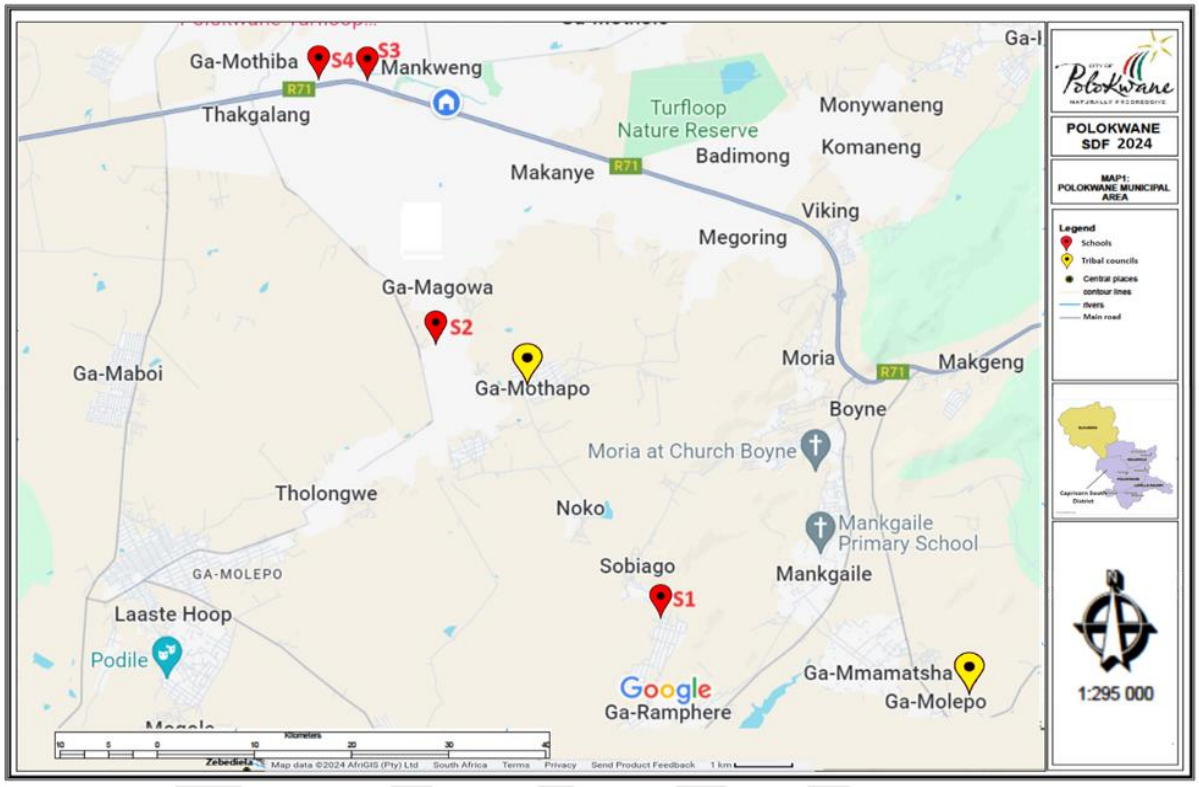


Figure 5.1: The research site of four primary schools

Source: (Map data, 2024)

5.2 DATA PREPARATION

This section delineated how raw data from semi-structured interviews, document analysis and non-participant observation were prepared for analysis.

5.2.1 Interview Data

The researcher used an audio recorder to record the participant-researcher conversations and to solicit their lived experiences using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners during the interview sessions. During transcription, the researcher independently transcribed the data by listening and writing down the participants' verbatim to become familiar with the data and recognise codes before actual analysis, as is emphasised in hermeneutic phenomenology (Monaro, Gullick & West, 2022). Furthermore, the researcher read

each transcription against the interview questions, which made her familiar with the data. She listened to the interview audio recordings, read each transcript several times, and asked herself what each segment could mean. This also assisted in making sure that there were no errors or omissions. Additionally, the supervisor received the transcribed data, which she used to confirm the information's authenticity and integrity using the research and interview questions (Muthanna & Alduais, 2023). The fluidity of the semi-structured interviews enabled the participants to introduce issues that the researcher had not expected. As such, rich and thick data about the educators' lived experiences using Africanised play-based pedagogy was obtained. Appendix H is attached as an example of an interview transcript.

5.2.2 Document Data

After data transcription from interviews was completed, the researcher requested four educators' copies of lesson plans and learners' activity books to corroborate what they said during the interviews, how they planned their lessons, and the impact of lessons on learners' achievement in mathematics activities. The researcher extracted data from four Grade 3 educators' lesson plans from four primary schools. A copy of data from the documents is in Appendix I. The researcher typed the information gathered from lesson plans and learners' activity books into the text. Each school's data from the documents was saved in a separate electronic folder.

5.2.3 Non-Participant Observation Data

Without participating in teaching and learning activities, the researcher observed four Grade 3 educators from four different primary schools teaching learners mathematics. The researcher documented the information gathered from classrooms to explore using Africanised play-based pedagogy in teaching FP learners' mental mathematics. A copy of observation data is attached as Appendix J to answer questions about what she observed in the classrooms. The observation data was saved in different electronic folders against each school.

5.3 DATA ANALYSIS

As stated in Section 1.6.6, data analysis is a process of gathering and organising data from selected research collection tools to manage it. Asenahabi (2019) asserted that data analysis divides data so a researcher can manage it. This was indicated in

Section 1.6.6; from the perspective of this study, interpretative phenomenological analysis is chosen. This analysis strategy is well discussed in Section 1.6.6. In addition, Rajasinghe and Garvey (2023) emphasised that interpretative phenomenological analysis concerning subjective epistemology interprets participants' lived experiences to understand the phenomenon under the study.

Interpretative phenomenological analysis was used to explore educators' subjective realities through interpretations of their lived experiences and the meaning they attach to these experiences. The collected data was analysed through the interpretative phenomenological analysis to explore using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. This is directed by Jedličková et al. (2022) and Rajasinghe and Garvey (2023) that this strategy explores participants' subjective realities by interpreting their lived experiences. Given this, semi-structured interviews, document analysis and non-participant observation data were analysed through a literature review and theoretical framework. Among other analysis strategies in qualitative research, interpretative phenomenological analysis is the most relevant to this study because of its ability to interpret the lived experiences of educators and allow the researcher to explore the phenomenon under study.

The data set emanated from semi-structured interviews, document analysis and non-participant observation. Following the model of Smith, Flowers, and Larkin (2022) in IPA, the researcher analysed the semi-structured interview data. The data from documents was analysed by answering the questions set out in the document analysis tool. An observation schedule was used to answer the questions from the interview schedule as data analysis.

The researcher sought to produce credible results and apply ethical research measures. Thus, the researcher provided the most accurate portrayal of participants' views and lived experiences on using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners while acknowledging her constructions and interpretations. This involved carefully considering how she heard voices during the data-gathering process and at every subsequent stage. This study followed the model of Smith et al.'s (2022) interpretative phenomenological analysis, which enabled the researcher to analyse data in line with the aim of the study.

5.3.1 Reading and Re-Reading the Data Sets

In the first step of implementing the Smith et al. (2022) model, the researcher started by reading each data set several times to get the gist of what educators were saying verbally and how the subject-matter had affected their lived experiences. The left-hand margin was used to annotate what is significant about what each educator said. The researcher re-read the data to ensure a better understanding of it.

5.3.2 Make Initial Notes or Comments

Using comments, the researcher commented on the similarities and differences, echoes, amplifications and contradictions in what educators said (Smith et al., 2022). The researcher also commented on document and observation data related to Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners.

5.3.3 Create Experiential Statements – Refine Notes into Assertions

The researcher systematically cross-examined three data sets from interviews, documents and non-participant observations to recognise the text's central ideas. This made applying a code (concepts or phrases) easier to represent the researcher's meaning. Guided by IPA, the researcher revisited audio recordings for interviews to understand and interpret what was constructed by the participants before coding the data (Love, Vetere & Davis, 2020). In the first coding stage, the researcher highlighted text sections and opened new comments to write code on a Word document for each data set. The codes were created from the keywords of interview questions that aligned with the study's research questions. The codes represented the researcher's understanding of what the educators had experienced using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners.

During the second stage of re-coding, the researcher created a project named "using the interpretative phenomenological analysis" on NVivo 14. Three files were uploaded on NVivo software: interview transcript, document and observation data. Before re-coding data electronically, the researcher entered the exact codes used manually. After the researcher had re-coded the data, the supervisor co-coded data using NVivo to ensure quality. The least codes were not executed. This was done to ensure the

authenticity and consistency of data through multiple coding (Kawamoto, Koizumi & Yoshikane, 2023). Data saturation was reached when no new codes arise from the dataset (Naaem et al, 2024). Table 5.2 summarises created codes.

Table 5.2: Summary of codes

Codes	Number of codes	Reference of PETs	Total
Africanised play-based pedagogy	21	51	72
Legislative framework	15	19	34
Mental mathematics	17	96	113
Online teaching	17	83	100
Strategies	10	15	25
Suitable play-based activities	6	16	22
The role	43	89	132
The use	95	296	396

Table 5.2: Illustrated the number of codes and reference statements from all data sets that revolved around the aim of the study. Column 2 of Table 5.2 exemplifies the number of codes, while column 3 indicates phenomenological statements per each data set. The last column shows the total number of codes and reference statements. As indicated in Table 5.2, the highest code was “the use,” with a total of (396) followed by “the role” (132). “Suitable play-based activities (22)” was recorded as the lowest, followed by “strategies” (25). The other code that was lowest was the “legislative framework” (34). This indicates that even though educators have lived experiences on the use and role of Africanised play-based pedagogy, they still experience challenges regarding suitable play-based activities, strategies and legislative frameworks. A codebook generated from Nvivo is attached as Appendix K.

5.3.4 Develop Personal Experiential Themes (PETs)

Another step aligned with the Smith et al. (2022) model is to develop PETs of educators. The researcher encapsulated the “essence” of the educators’ experiences by clustering experiential statements. This is also known as the category stage.

Because IPA emphasises the importance of reflections, the researcher imported literature and theoretical chapters into NVivo as memos. Table 5.3 shows how the researcher linked the study's research questions and components of the theoretical framework.

Table 5.3: A link between the research questions and components of the theoretical framework

Research questions	**Components of the theoretical framework**
Main Research Question: How can Africanised play-based pedagogy be used in the online teaching of mental mathematics to FP learners?	3. Integration of Africanised play-based pedagogy in teaching and learning mathematics 4. The role of MKO in teaching mathematics
Research Question 2: What role does Africanised play-based pedagogy play in the online teaching of mental mathematics to FP learners?	5. The role of cultural activities in teaching and learning mathematics 6. ZPD
Research Question 3: What are suitable African play-based activities for the online teaching of mental mathematics to FP learners?	7. ZPD
Research Question 4: What legislative frameworks guide teachers using Africanised play-based pedagogy in the FP?	8. The role of MKO in teaching mathematics
Research Question 5: What strategies do educators use to support learners when using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners?	9. The role of MKO in teaching mathematics

The research questions were formulated to understand educators' perspectives on the phenomenon. However, the philosophical assumptions underpinning the study

influenced how the researcher interpreted the views and lived experiences of educators to make meaning to explore the use of Africanised play-based pedagogy play in the online teaching of mental mathematics to FP learners. Table 5.3 shows that the main question was: *How can Africanised play-based pedagogy be used in the online teaching of mental mathematics to FP learners?* linked with the role of MKO in teaching mathematics and integrating Africanised play-based pedagogy in teaching and learning mathematics. The second question: *What role does Africanised play-based pedagogy play in the online teaching of mental mathematics to FP learners?* was aligned to the role of cultural activities in teaching and learning mathematics and ZPD. The third question: *What are suitable African play-based activities for the online teaching of mental mathematics to FP learners?* was connected to ZPD.

Meanwhile, Question 4: *What legislative frameworks guide teachers when using Africanised play-based pedagogy in the FP*? and Question 5: *What strategies do educators use to support learners when using Africanised play-based pedagogy in the online teaching of mental Mathematics to FP learners?* relate to the role of the MKO in teaching mathematics.

Linking the research questions with the components of the theoretical framework assisted in identifying categories in line with the codes created on NVivo. Table 5.4 shows the relationship between categories and codes.

Table 5.4: The relationship between categories and codes

Category	**Code (s)**
The role of MKO in teaching mathematics	10. Africanised play-based pedagogy 11. Legislative framework 12. Mental mathematics 13. Online teaching 14. Strategies 15. Suitable play-based activities 16. The role

Category	Code (s)
	17. The use
The role of cultural activities in teaching and learning mathematics	18. The role 19. Mental mathematics 20. Africanised play-based pedagogy
Integration of Africanised play-based pedagogy in teaching and learning mathematics	21. Suitable play-based activities 22. Mental mathematics
ZPD	23. Suitable play-based activities 24. Mental mathematics 25. The role 26. The use

The components of the theoretical framework assisted in formulating the categories that align with the codes, as indicated in Table 5.4. This was done to ensure that the theoretical framework served as a guide throughout the study. The reflexive journal is discussed in the next section as it helped with data presentation in hermeneutic phenomenology.

5.3.5 Creating a Reflexive Journal

Guided by Stanier(2022), the researcher created a reflexive journal for data analysis as required in hermeneutic phenomenology research design. The researcher used the memo feature in NVivo to import the hermeneutic cycle, theoretical framework, reviewed literature and reflexivity to make reflections as she was analysing the data. Considering the philosophical assumptions of interpretivism research, the researcher used a reflexive journal to avoid interjecting her lived experiences into the lived experiences of educators who participated in the study. Similarly, following IPA, the researcher allowed the emerging ideas from Grade 3 educators involved in think-aloud and stimulated interview sessions to be used without misinterpreting their core meaning.

The researcher exported visualisations, generated reports and ran queries that supported data presentations that helped the presentation of findings. To do this, educators' lived experiences collected through semi-structured interviews were corroborated by the data from lesson plans and learners' activity books. Lastly, the lived experiences with interpretations from the documents were triangulated with the data from observations.

5.4 PRESENTATION OF FINDINGS

The data from semi-structured interviews, document analysis and non-participant observations are used to present the findings. The researcher ensured that her interpretation and descriptions of the educators' life experiences in the classroom confirmed the lived experiences of FP educators, while the interviews elicited their experiences. The results from the lesson plans and learners' activity books were added to support the lived experiences and the interpretations.

5.4.1 The Use of Africanised Play-Based Pedagogy in the Online Teaching of Mental Mathematics

The study's primary research question asked *how Africanised play-based pedagogy can be used in the online teaching of mental mathematics to FP learners*. This question links to the integration of Africanised play-based pedagogy in teaching and learning mathematics and the role of MKO in teaching mathematics.

5.4.1.1 The reconstruction of educators' lived experiences on the use of Africanised play-based pedagogy from the semi-structured interviews

To elicit educators' lived experiences on the phenomenon, Question 7 from the interview schedule asked: *How can FP learners be taught mental mathematics online using an Africanised play-based pedagogy?* The findings indicated that most educators' have lived experiences of mental mathematics teaching FP learners. A hierarchy chart generated from NVivo, Figure 5.2, confirms that most experiential statements are from interviews, documents and observation data, explaining that educators understand how to teach mental mathematics effectively. Figure 5.2 presents a hierarchy chart generated from NVivo.

Figure 5.2: Educators' lived experiences using Africanised play-based pedagogy

Figure 5.2 illustrates a set of nested rectangles of varying sizes that represent the number of patterns in the coding of each file. A typical key finding is that educators have lived experiences with mental mathematics followed by online teaching and Africanised play-based pedagogy. Some educators indicated that they used the African context in teaching and learning mathematics to FP learners, in conjunction with Vygotsky's sociocultural theory, and they understood their roles as MKO. The educators revealed that they understood their roles in teaching mental mathematics concerning meeting the demands of CAPS. As such, acquiring knowledge of teaching mental mathematics and using online teaching are socially constructed, and experienced phenomena occurred best in their real workplaces and professional interactions. The educators were excited to say:

> *"Our school is equipped with Wi-Fi and smartboards. We can play the games we used to play on the smartboards for the learners. Even at home, learners have smartphones and smartboards. We can also urge educators to set up activities that feature cultural elements that young kids can play. During classes, these games can also be shown on smartboards*". (S2FPE3)

> *"I would look up videos on Google that link to the mathematics topic of the week. I wish to teach kids addition techniques, for instance. Since we are discussing Grade 1 learners, I suggest zero to twenty. Songs that relate to the subject would be sent to me".* (S3FPE1)

S1FPE3, S3FPE2 and S4FPE2 described using play-based activities that infuse culture by searching online web videos. Africanised play-based activities such as Diketo and Skipping Rope. They mentioned:

> *"Online resources that employ African play-based education are scarce. On the other hand, I can produce web content that might benefit other teachers. For instance, the Diketo game teaches counting and multiplication to learners. This shows that old techniques of teaching young learners are mixing with new ways. Learners can use the tablets to view a video and then go outside the classroom to play the games. Learners can learn number patterns with this game. Multiples of two or four, for instance. Sometimes, I must use technology in my classes, like taking learners to a smart room. I will start by playing a video related to the ideas I discussed in my lesson. This helps learners understand mathematics".* (S1FPE3)

> *"I could get images of different cultures. Videos are also available for download. For instance, you can google a picture or a video of kids having fun with a skipping rope. I would go over it again with the projector".* (S3FPE2)

> *"I can use a variety of YouTube mathematical play games for mental math. I believe that by playing the Diketo game offline afterward and seeing it on YouTube. Learners can pick up mathematical ideas from this game. I would make a circle and fill it with a specific quantity of stones. I would also advise my learners that we must gather stones in pairs. This implies that they would pick up number patterns in twos. Next, they must tally how many stones they took out of the circle. They would also learn how to count from it. I will go outside with learners in groups of ten and even teach them how to skip a rope. This will enhance mathematical grouping abilities. I will give each learner four chances to skip the rope. This will teach them four-symbol patterns. One person would skip the ropes eight times, while another would do it twelve times. I would also challenge them, such as: How many times does the learner who comes after need to skip a rope? After that, learners would recognise patterns of four".* (S4FPE2).

A challenge of limited Africanised play-based pedagogy that could be used online to teach learners mathematics was raised by S2FPE1. This indicates the need for

experiences of selecting relevant African play-based activities online to teach learners mathematics. Hence, they demonstrated Africanised play-based games such as Skipping Rope and Diketo through their smartboards and projectors. Even though S1FPE2 and S4FPE1 mentioned Africanised play-based activities (Morabaraba game) that could be used online, they needed to learn how to use it online to teach FP learners mathematics. A probing question that asked: *How would you use Morabaraba online to teach learners mathematics?* was posed to S4FPE1 as a follow-up. S4FPE1 responded:

> *"I think using different games that I have mentioned, such as Chess, Diketo and Morabaraba, to develop a sense of mathematical skills for FP learners. It is just that I do not know how to play them both physically and through smartphones or tablets.*" (S4FPE1).

This could indicate that some educators must learn about playing Africanised play-based activities online.

Question 8 of the interview schedule sought to solicit other ways educators integrate Africanised play-based pedagogy in online teaching of mathematics to FP learners. The findings presented that educators use online rather than Africanised play-based pedagogy to teach mathematics in the FP. S2FPE2, S4FPE2 and S4FPE3 were deliberating about using Kahoot as part of the online teaching of mathematics in the FP. S2FPE2 explained that they did not use Kahoot at School 2, but as a parent with a FP child, they assisted children at home. S2FPE2 expressed this from the parent's perspective:

> "*We do not use Kahoot in our school. I know it from my child's school. They urge parents to download the Kahoot app from their smartphones. We were given guidelines by the educators. They provide us with URLs and pins to enter the competition. They inform us about the start and end times of the competition. When you log in, you will find different questions a child needs to answer. Kahoot provides instant feedback after each question".* (S2FPE2).

However, it was revealed by S4FPE3 that they used Kahoot only during competitions. The issue of shortage of technological devices was raised again. They needed more tablets for learners at School 4, and they could not access the Wi-Fi. Educators used

their own data, which was a problem. As such, educators use Kahoot only during the competitions. S4FPE3 said:

> *"By using Kahoot, I may say. Honestly speaking, though, we do not use it that often. The circuit manager never allows learners to use it; instead, we only use it in response to messages like, "This time, I will be coming to the school, and I need to see this. You understand that?" When I say, "Get ready for Kahoot," they get excited. Because they do not do it frequently, learning becomes challenging. We exclusively participate in it during interschool contests. If there are no competitions, we essentially do not use it for teaching and learning activities. The gadgets are limited, and we only get them during the competitions. I was only told in 2022 when I was told there are tablets for learners. Our school has challenges since many teachers have an internet connection. They did not provide us with the password for our Wi-Fi. During teaching and learning activities, we occasionally use our data."* (S4FPE3)

Other ways of teaching online from educators are demonstrated as a word cloud in Figure 5.3, generated from the NVivo.

Figure 5.3: Word cloud illustrating the use of online teaching platforms

As illustrated in Figure 5.3, educators used online teaching platforms such as Kahoot, YouTube, videos, the Internet and Google. As depicted in Figure 5.4. videos appear twice because educators believed they could demonstrate videos of Africanised play-based activities through their laptops, smartphones and smartboards to teach mental mathematics.

5.4.1.2 Educators' lived experiences from the think-aloud interview sessions

The think-aloud interview sessions were designed to request the educators think and speak aloud about how they would implement a lesson on using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners, as explained in Section 6.7 (Chapter 4). Only Grade 3 educators from four schools were involved in the think-aloud interview sessions.

When answering Question 17 from the interview schedule to solicit how educators would use Africanised play-based pedagogy online to teach their learners mental mathematics, only S1FPE3 and S3FPE3 discussed that they would use games such as Sudoku and Morabaraba. They explained that they would demonstrate a video of this game to learners. S3FPE3 said:

> *"I integrated an indigenous game called Morabaraba. Through the projector, I demonstrated how this game is played. I showed learners how to play Morabaraba and its rules. I incorporated mathematical concepts like patterns, geometry, and algebra in mental mathematics" (S3FPE3).*

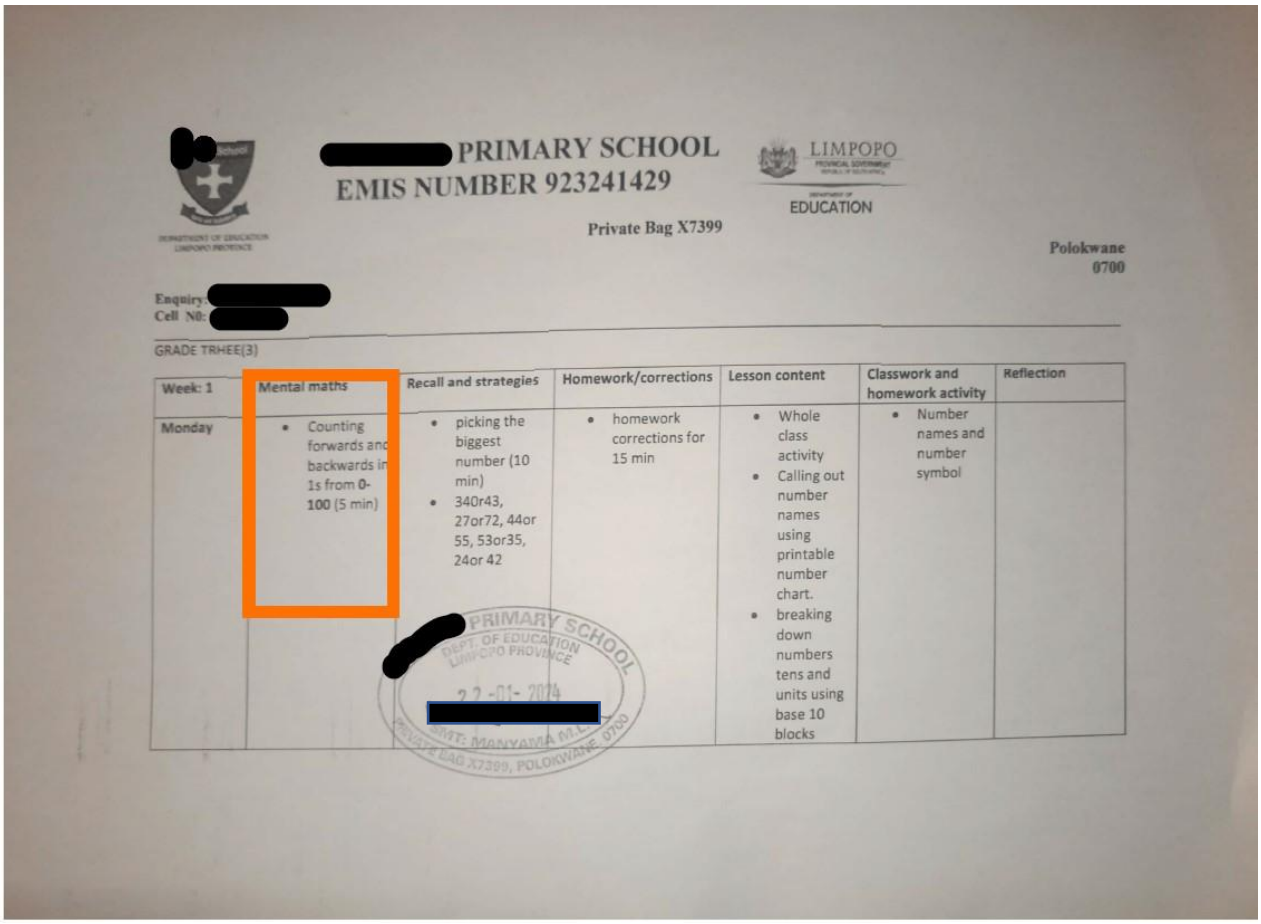
S2FPE3 and S4FPE4 articulated the idea of displaying videos of Tsheretshere and Dibeke games, respectively. The challenges of using Africanised play-based pedagogy when teaching mathematics online were highlighted by S4FPE4. S4FPE4 said:

> *"It was hard to use play that integrates African culture in teaching mental mathematics. However, I used a game that incorporates numbers to teach learners patterns. Learners played the Dibeke game physically while counting numbers from zero to ten. If I knew how to use an indigenous game online, I would have used it".* (S4FPE4)

5.4.1.3 Educators' lived experiences from the documents

Lesson plans from four educators such as S1FPE3, S2FPE3, S3FPE3 and S4FPE3, corroborated that educators need to gain knowledge on using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. None of the Grade 3 educators from four different public primary schools planned to use Africanised play-based pedagogy in teaching mental mathematics to their learners.

The educators are guided by the lesson plan from the National Education and Collaboration Trust (NECT) to develop their lesson preparation. Even though educators explained that using online teaching platforms during the interviews, they needed to integrate them into their lesson plans. Figure 5.4 shows the lesson plan from S1FPE3.



[redacted] PRIMARY SCHOOL
EMIS NUMBER 923241429
Private Bag X7399
LIMPOPO
EDUCATION
Polokwane
0700

Enquiry: [redacted]
Cell N0: [redacted]

GRADE THREE(3)

Week: 1	Mental maths	Recall and strategies	Homework/corrections	Lesson content	Classwork and homework activity	Reflection
Monday	• Counting forwards and backwards in 1s from 0-100 (5 min)	• picking the biggest number (10 min) • 340r43, 27or72, 44or 55, 53or35, 24or 42	• homework corrections for 15 min	• Whole class activity • Calling out number names using printable number chart. • breaking down numbers tens and units using base 10 blocks	• Number names and number symbol	

[redacted] PRIMARY SCHOOL
DEPT. OF EDUCATION LIMPOPO PROVINCE
22-01-2024
PRINCIPAL: MANYAMA M.C.
PRIVATE BAG X7399, POLOKWANE, 0700

Figure 5.4: A copy of the lesson plan from S1FPE3

5.4.1.4 Educators' life experiences from the non-participant observations

The observations occurred in week 2 of term 1; educators focused on numbers, operations and relationships. What educators said during the think-aloud interview was only some of what was implemented in the classrooms. S1FPE3's lesson was about number names and symbols. During mental mathematics, learners were counting backward and forward. The Africanised play-based pedagogy was not used. Online teaching platforms were not integrated, and the intelligent classroom was occupied because the whole school used it for teaching and learning. The educator

used a Sudoku game as an assessment activity for remedial education. As displayed in Figure 5.5, S1FPE3 did not include Sudoku in lesson planning.

In S2FPE3's classroom, the learners counted forward and backward during mental math. The educator displayed the numbers the learners were counting using a laptop, smart board and projector. The educator used PowerPoint presentations (PPT) through the smartboard during the lessons. S2FPE3 demonstrated the Tsheretshere counting method. However, the teacher physically played it as she showed the learners the numbers on the smart board. The educator taught about more significant than, less than and equal to during concept development. The educator started by recapping what learners did in Grade 2.

In S3FPE3's classroom, a video of the Diketo game was shown through a projector during the mental mathematics class. To help learners with counting skills, the teacher played a video of the indigenous game Diketo. They participated in separate teams. Using paper and bottle tops, they were engaging in physical play. During the Diketo game, learners were told to choose a leader. The educator showed a song from YouTube via a link. The teacher assisted learners with number names and symbols by offering them several videos accessed from the Thutong website. The educator used a video in the Sepedi language.

S4FPE3 implemented activities from the NECT lesson plans. During the interviews, the educators discussed how she would apply play-based pedagogy with an Africanised perspective. Neither Africanised play-based pedagogy play-based activities nor any online teaching platforms were used by the teacher when teaching mental mathematics.

5.4.1.4 Educators' lived experiences from the stimulated recall interview session

After the lesson observations, the researcher requested educators to reflect on the think-aloud interview and the lesson implementation. Question 21 asked educators to critique their lessons. S1FPE3 complained that the time for mental mathematics was insufficient because she took ten minutes for mental mathematics. However, the NECT encourages educators to use 15 minutes for mental mathematics as it is divided into two sections: counting (5 minutes) and recall and strategies (10 minutes).

Conversely, S2FPE3 and S3FPE3 mentioned that their lessons went well. However, S3FPE3 said:

> "…*had they had their tablets, it would have been perfect*".

S4FPE4 explained that Africanised play-based activities that could be done online could not be used because she did not know a suitable play activity. An indigenous game called Dibeke was used. This indicates that educators have difficulties using Africanised play-based pedagogy online to teach mental mathematics.

5.4.2 The Role of Africanised Play-Based Pedagogy

The study's second research question asked: *What is the role of Africanised play-based pedagogy in the online teaching of mental mathematics?* This question relates to the lens of the theoretical framework, such as the role of cultural activities in teaching and learning mathematics and the integration of Africanised play-based pedagogy in teaching and learning mathematics.

5.4.2.1 The reconstruction of educators' lived experiences on the role of Africanised play-based pedagogy from the semi-structured interviews

This is in response to question twelve from the interview schedule concerning the significance of using Africanised play-based pedagogy in teaching mental mathematics to FP learners online. Educators showed that they understood their roles as MKO, the role of cultural activities in teaching and learning mathematics, and the importance of integrating Africanised play-based pedagogy in teaching and learning mathematics. Figure 5.5 shows a bar graph generated from the NVivo that emphasises the role of Africanised play-based pedagogy in the online teaching of mental mathematics by the participants.

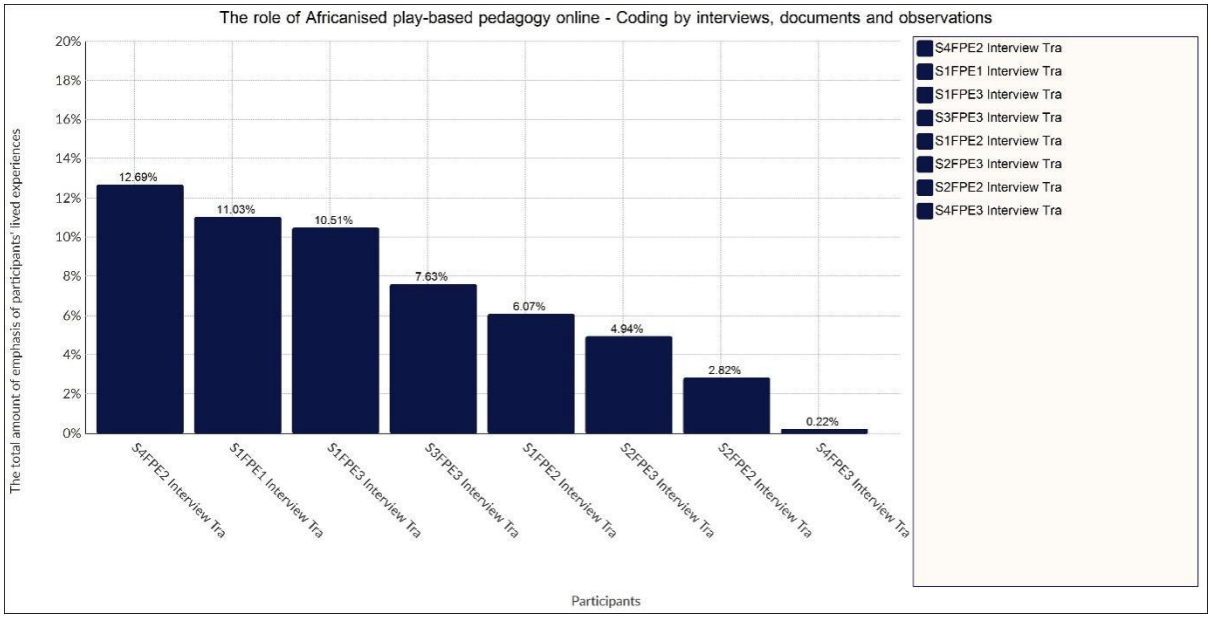


Figure 5.5: The role of Africanised play-based pedagogy

Figure 5.5 highlights the total percentage of codes on the role of Africanised play-based pedagogy in the online teaching of mental mathematics per interviews, documents and observation data. As shown in Figure 5.5, the lived experiences emerged from the interviews from eight educators: S4FPE2, S1FPE1, S1FPE3, S3FPE3, S1FPE2, S2FPE3, S2FPE2 and S4FPE3. Thus, experiential statements from S4FPE2, S1FPE1, and S1FPE3 were provided in full for close reading and engagement of participants on the role of Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. S1FPE1 and S2FPE3 clarified that their role was to help learners build their ability to solve mathematical problems. S1FPE1 described their experiences:

> "*Ludo game, for instance, teaches learners how to solve mathematical puzzles and be responsible. Learners should be able to defend themselves from the assailants while they play this game. They can solve challenges in real life because of this. It instils independence in them*" (S1FPE1).

Conversely, S1FPE2 and S2FPE1 discussed that Africanised play-based pedagogy develops learners' social skills in the classroom. S3FPE1 and S4FPE2 substantiated the development of technology skills in learners through online mathematics teaching to FP learners. S1FPE3 brought up an appreciation of culture and identity. S1FPE3

distinguished between learners who are technologically and culturally intelligent during conversations. S1FPE3 provided evidence for this:

> *"Since culture broadens learners' comprehension of mathematics, it would be beneficial to incorporate it into mathematics teaching. With an Africanized perspective, online teaching and play-based pedagogy can benefit learners from diverse backgrounds. It accommodates various learning styles as well. Because learners differ from one another and do not all acquire their information from the same pedagogy, it may be able to accommodate learners with learning disabilities. While some learn from video games, others learn from African culture. Some are e-learning savvy; some are culturally smart. It helps our kids rediscover their African identity and culture"* (S1FPE3).

Other educators proposed that various roles of Africanised play-based pedagogy, including improving counting skills, mathematical thinking skills, long-term memory and excitement for mathematics-related activities. A follow-up inquiry (Question 15) asked educators to give their views and experiences on the function that Africanised play-based pedagogy serves in teaching FP learners mental mathematics online. S2FPE1, S2FPE3, S3FPE1, S3FPE3 and S1FPE2 said this phenomenon could develop learners' counting skills. S1FPE2 said:

> *"They improve their [learners] ability to count forward and backward. It helps with the recognition of numbers, sharing and grouping. It teaches children how to interact with other people. They enhance learners' cognitive abilities by observing the online Google and YouTube videos. For instance, I can use my smart TV to stream a video on how to play Diketo, and learners can watch and use the teacher-provided resources—like stones—while they play. This allows learners to learn number patterns"* (S1FPE2).

The development of problem-solving skills was brought up again when S1FPE1 highlighted:

> *"Even in teaching and learning activities, indigenous knowledge is helpful. Learners should be able to connect what they learn in the classroom to real-world situations and to solve mathematical problems. Learners need to recognise the significance of culture in our day-to-day endeavours".* (S1FPE1).

Nevertheless, S2FPE2 was at a loss for words when explaining it. A pause ensued before the following was said:

> "*I do not know how to explain it."* (S2FPE2).

The findings show that educators used Africanised play-based pedagogy online to develop learners' mathematical skills, such as counting. Figure 5.6 illustrates a word cloud on the role of Africanised play-based pedagogy in the online teaching of mental mathematics generated from NVivo.

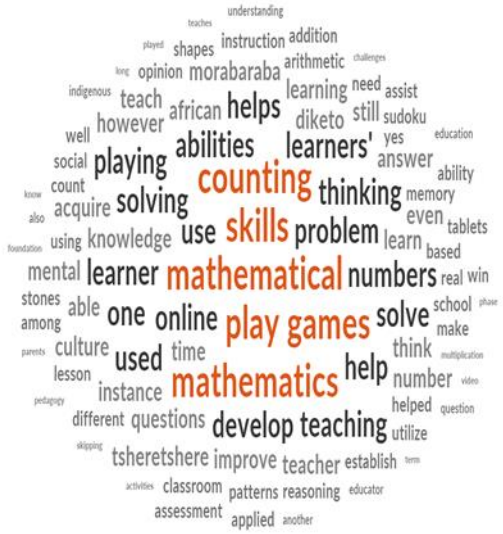


Figure 5.6: A word cloud on the role of Africanised play-based pedagogy

As illustrated in Figure 5.6, educators' role in Africanised play-based pedagogy in the online teaching of mental mathematics is to develop mathematical and counting skills for FP learners.

In Question 15, educators were questioned about the roles of integrating African games in teaching mathematics in their past experiences. S1FPE2, S1FPE3, S4FPE2 and S4FPE3 said they extended learners' memory in teaching mathematics. S1FPE3 mentioned that they used to look down on African games in teaching mathematics in the FP. S1FPE3 verbalised:

> *"We used to limit our attention to using African games in traditional education. The games helped learners learn how to think quickly and solve mathematical difficulties. For instance, my FP teacher employed African games to help*

learners learn arithmetic through long-term memory. As a teacher, I applied them to enhance learners' mathematics comprehension.

Additionally, it promotes the drilling method among educators. Learners engage in outdoor play to help each other comprehend the day's material. It could involve addition, subtraction or counting". (S1FPE3).

The development of counting skills was mentioned again by S1FPE1, S2FPE1, S2FPE2, S2FPE3 and S3FPE1. Some of these educators also emphasised that when Africanised play-based pedagogy is used online, it enhances learners' counting skills. They articulated:

"*The Diketo game, for instance, teaches counting. Learners must be able to count the stones. The winner is the learner or the team with the most stones collected. The objective is to gather more stones*". (S1FPE1)

"They teach learners multiplication of numbers and counting skills." (S2FPE3)

"*They were assisting with mathematical skills. Through using Tsheretshere; learners develop a sense of different shapes and counting skills".* (S3FPE1)

According to S3FPE2 and S4FPE1, African games impart mathematical knowledge, while S3FPE3 explained how African games support learners' mental health and the development of social skills in a probing question. S3FPE3 highlighted:

"*Since they are part of physical activities, they help to maintain their mental health. To converse with others. I am still attempting to analyse a constantly quiet learner in my classroom. She is rarely noisy and by herself. She stays silent with me. I invited more learners to play with her. I do not know; maybe she is going through something. However, when learners play together, they improve their social abilities. They gain knowledge from one another as they converse. Education knowledge is then transferred*". (S3FPE3).

5.4.2.2 Educators' lived experiences on the role of Africanised play-based pedagogy from the think-aloud interview sessions

Question 18 asked: *What role does Africanised play-based pedagogy play in the online teaching of mental mathematics to FP learners?* During think-aloud interview

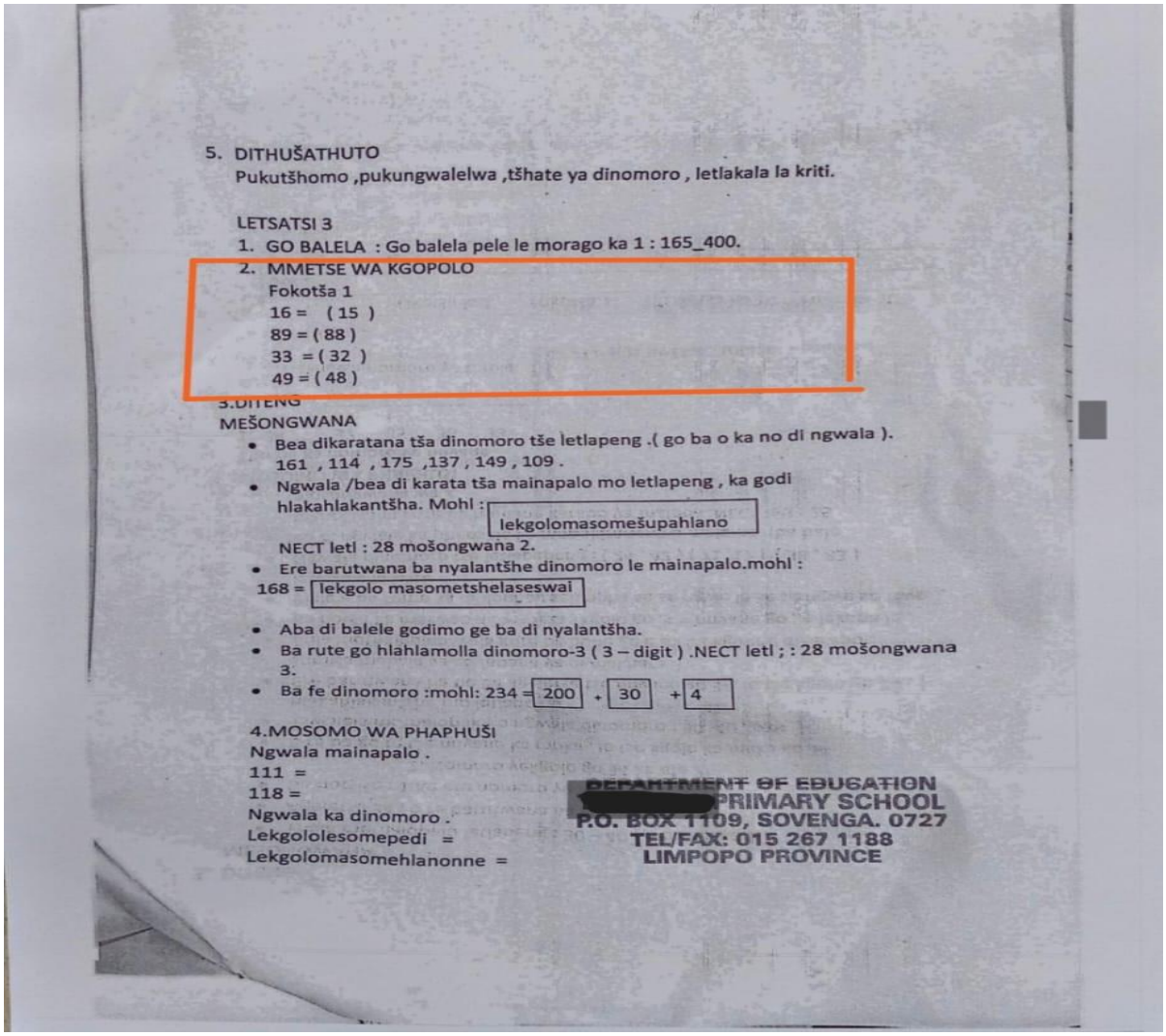
sessions. S1FPE3 and S3FPE3 explained that the role of their lesson was to use Africanised play-based pedagogy online to develop learners' problem-solving skills. S3FPE3 said:

> "*Morabaraba engages learners in problem-solving skills. As learners play this game, they can solve problems to win it. They challenge each other. It indicates a problem that learners need to solve. When a learner puts a challenge to their peer, the different learners need to solve it. To win this game, learners must have algebraic and mathematical thinking skills".* (S3FPE3).

S2FPE3 and S4FPE3 explained that learners develop mathematical, critical thinking and counting skills.

5.4.2.3 Educators' lived experiences on the role of Africanised play-based pedagogy from the Documents

Even though the interview findings indicate that educators have lived experiences on the role of Africanised play-based pedagogy in the online teaching of mental mathematics, their lesson plans show that they do not include it in their lesson plans. There needs to be evidence from the lesson plans regarding the relevance of this approach in teaching mathematics. Lesson objectives and aims should be indicated in the lesson plans. Referring to Figure 5.5, the lived experiences of educators on this phenomenon were raised only in the interviews. A copy of the lesson plan from S3FPE3 is attached as Figure 5.7.



5. DITHUŠATHUTO
Pukutšhomo ,pukungwalelwa ,tšhate ya dinomoro , letlakala la kriti.

LETSATSI 3
1. GO BALELA : Go balela pele le morago ka 1 : 165_400.
2. MMETSE WA KGOPOLO
Fokotša 1
16 = (15)
89 = (88)
33 = (32)
49 = (48)

3.DITENG
MEŠONGWANA
- Bea dikaratana tša dinomoro tše letlapeng .(go ba o ka no di ngwala).
161 , 114 , 175 ,137 , 149 , 109 .
- Ngwala /bea di karata tša mainapalo mo letlapeng , ka godi hlakahlakantšha. Mohl : lekgolomasomešupahlano
NECT letl : 28 mošongwana 2.
- Ere barutwana ba nyalantšhe dinomoro le mainapalo.mohl :
168 = lekgolo masometshelaseswai
- Aba di balele godimo ge ba di nyalantšha.
- Ba rute go hlahlamolla dinomoro-3 (3 – digit) .NECT letl ; : 28 mošongwana 3.
- Ba fe dinomoro :mohl: 234 = 200 + 30 + 4

4.MOSOMO WA PHAPHUŠI
Ngwala mainapalo .
111 =
118 =
Ngwala ka dinomoro .
Lekgololesomepedi =
Lekgolomasomehlanonne =

DEPARTMENT OF EDUCATION
[redacted] PRIMARY SCHOOL
P.O. BOX 1109, SOVENGA. 0727
TEL/FAX: 015 267 1188
LIMPOPO PROVINCE

Figure 5.7: A copy of a lesson plan from S3FPE3

As illustrated in Figure 5.8, the lesson plan from S3FPE3 needs to indicate the role of Africanised play-based pedagogy in the online teaching of mental mathematics. It only showed mental mathematics activities.

5.4.2.4 Educators' life experiences on the role of Africanised play-based pedagogy from the non-participant observations

From S1FPE3's classroom, Africanised play-based pedagogy (Sudoku game) assisted in developing problem-solving skills. Mathematical thinking skills, counting skills, social interaction and enthusiasm were evident, among other roles. Most, if not all, of the learners got all the marks. The learners engaged in the Tsheretshere game and developed mathematical thinking and counting skills as they played it in S2FPE3's classroom. The development of problem-solving, socialisation and mathematical

thinking skills was evident in S3FPE3's classroom. After watching the video of the Diketo game on the screen, learners played the game physically, following the rules. The learners could perform number patterns. However, learners needed help to get all the marks for the class activity. Figure 5.8 illustrates the copies of learners' activity books from S3FPE3. S4FPE3 did not employ play-based teaching; the learners counted backward and forward. It helped them develop mathematical thinking skills.

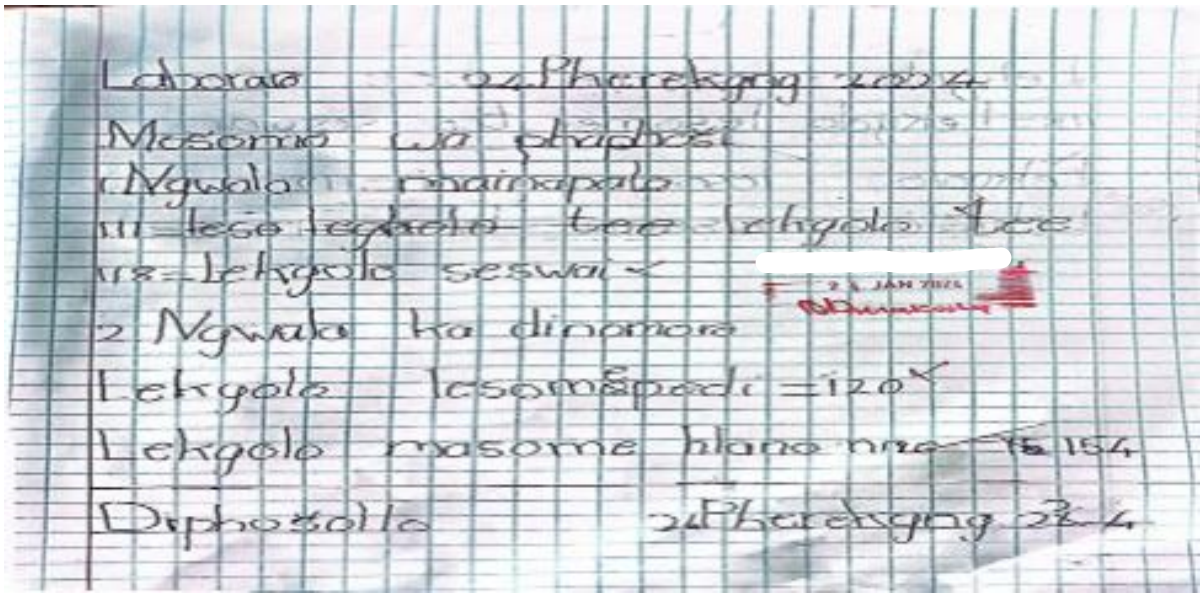


Figure 5.8: A copy of the learners' activity book from S3FPE3's class

5.4.1.5 Educators' lived experiences on the role of Africanised play-based pedagogy from the stimulated recall interview session

During the stimulated interviews, the researcher reminded each participant about what they mentioned about the roles of Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners during think-aloud interviews. S1FPE3, S2FPE3 and S3FPE3 said that Africanised play-based pedagogy assisted with problem-solving and mathematical thinking skills during the think-aloud interviews. When Grade 3 educators were asked Question 22 about how they assisted learners in achieving the roles of the lesson S1FPE3, S2FPE3 and S3FPE3, they made reflections by saying that through the use of Africanised play-based pedagogy, they were able to develop learners' problem-solving and mathematical thinking skills. S4FPE3 exclaimed that play-based pedagogy was not used in the classroom, but learners developed counting skills. S4FPE3 answered:

"*We did not use play, but through counting backward and forward, learners developed counting skills*" (S4FPE3).

Questions 23 and 24 aimed to discover what educators learned from their lessons and how they would modify their lessons if given the chance. The challenges of the scarcity of technology devices and limited Africanised play-based activities that could be played online to teach mathematics were raised again by S3FPE3 and S4FPE3. They stated:

> *"As I indicated in the think-aloud interviews, I would use Morabaraba. Because the other instructor reserved the tablets before me, I could not use them. I wanted learners to practice problem-solving by playing Morabaraba".* (S3FPE3)

> *"I would improve by incorporating online teaching."* (S4FPE3)

As a result, the findings indicate that educators understood that Africanised play-based pedagogy plays a significant role in the online teaching of mental mathematics. Interestingly, Africanised play-based pedagogy develops learners' problem-solving and mathematical skills. The most surprising role of Africanised play-based pedagogy is enhancing learners' counting skills in teaching and learning mental mathematics online.

5.4.3 Suitable African Play-Based Activities

The study's research question 3 asked about suitable African play-based activities for the online teaching of mental mathematics to FP learners. ZPD aligns with this research question.

5.4.3.1 The reconstruction of educators' lived experiences on suitable African play-based activities from the semi-structured interviews

In response to Question 12 from the interview schedule about which African play-based activities could be used in the online teaching of mental mathematics to FP learners, only a few educators indicated that they had experienced this phenomenon. Figure 5.9 illustrates a network generated from NVivo.

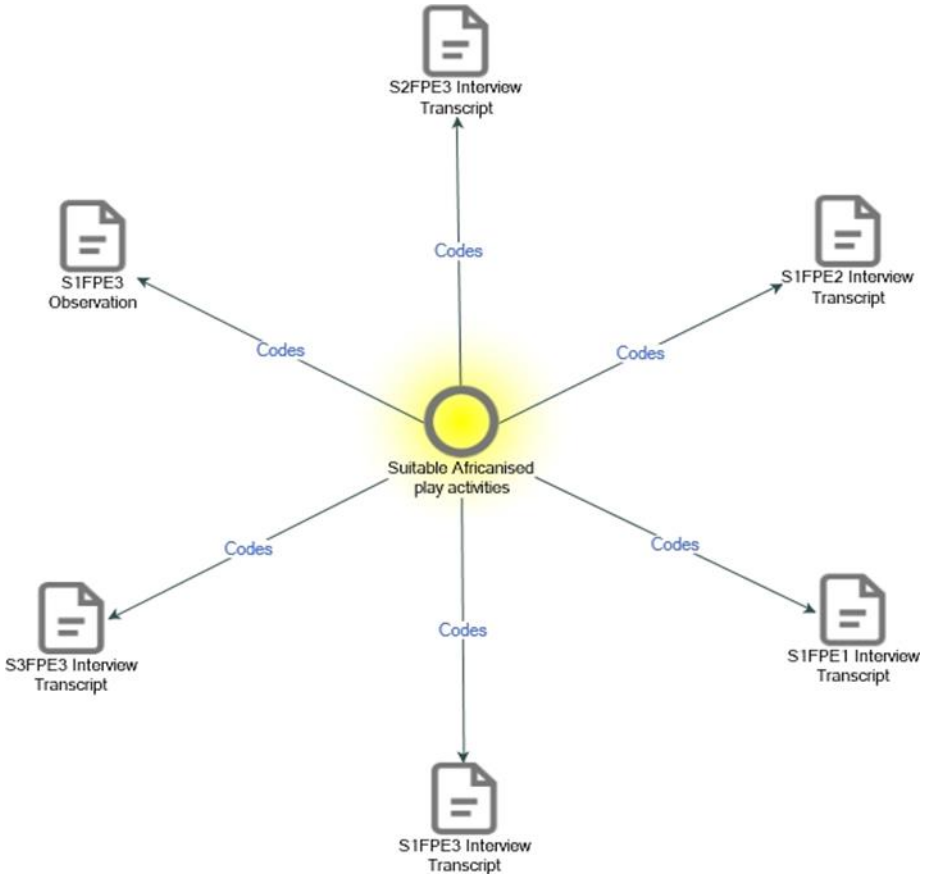


Figure 5.9: A network that shows suitable African play-based activities that could be played online to teach mathematics

Figure 5.9 showed that during the interviews, S2FPE3, S1FPE2, S1FPE1, S1FPE3 and S3FPE3 mentioned suitable Africanised play-based activities in the online teaching of mental mathematics. The researcher observed an African play activity that could be used in online education from S1FPE3's classrooms.

African play-based activities such as Math Zap Cards, Morabaraba, Sudoku, and Ludo were described by educators as African play-based activities that could be used online to teach learners mental mathematics. S1FPE2 and S2FPE3 mentioned card games. S1FPE2 explained:

> "…*Uno cards are the other. The cards feature various forms and regulations on the back. The kingdom has an impact on the rules. It displays each person's position inside the kingdom. They have separate numbers up front. Learners discover how to use various numbers to solve the kingdom's problems as they play. The learner who has no cards wins the game*" (S1FPE2).

From S1FPE2's descriptions, the researcher learned that educators understood that African games that could be played online can be used as a strategy in the ZPD to enhance learners' problem-solving skills.

On the same note, S3FPE3 explained that the Morabaraba and Sudoku games could be used as they assist mathematical skills.

> *"This question is difficult, eish. However, I believe Morabaraba might be used in online maths teaching. Though I have not played it much, I recently found the game on the Google Play Store. Additionally, there is the online game Sudoku, which incorporates various aspects of African cultures. The Sudoku game could be useful for teaching maths because it incorporates numbers and adding skills. Mathematical skills can be learned in the same way that learners can play online games. I am unsure how to play this game either" (S3FPE3).*

This indicates that educators needed to gain experience playing these games online. S4PFE2 discussed how learners could learn mental mathematics by playing a Sudoku game:

> *"When playing a Sudoku game, you solve a puzzle. Learners can complete one table at a time. It can either be numbers or shapes. FP learners could fill in the missing shape/s or number/s. For example, they have three shapes: a diamond, a square and a circle. The learners should know which is missing from the three shapes and fill in each column. It could be done with numbers from one to nine. The learner should check a number that is missing. It helps learners grow cognitively, improving their decision-making, mathematical thinking and problem-solving skills. In addition, this game teaches spatial awareness, positioning, measurement, number sense space, and shapes" (S4PFE2).* Even though S4PFE2 did not explain how Sudoku games could be played online, she has experience using this game to teach mental mathematics in the FP.

S1FPE1 explained that the Ludo game could enhance learners' counting, problem-solving and decision-making skills. S1FPE1 expressed:

> *"A Ludo game would be useful, as it aids learners in developing counting abilities. This game helps with problem-solving, decision-making and team-*

building skills. Learners will be able to defend themselves and solve real-life problems. Most importantly, it can be played online" (S1FPE1).

On the other hand, S2FPE1, S2FPE2, S3FPE2, and S4FPE3 explained that they did not think African games could be used online to teach learners mathematics. S4FPE3 stated:

> *"It would be difficult, particularly when incorporating indigenous games into online teaching because indigenous play-based activities are typically physical. It would be best if you had a certain competence in technology to enable learners to engage in play-based activities while simultaneously learning mathematical concepts actively. Not every teacher can do that"* (S4FPE3).

5.4.3.2 Educators' lived experiences on suitable African play-based activities from the think-aloud interview sessions

When educators were asked Question 19 on which Africanised play-based activity/activities they used in the online teaching of mental mathematics to FP learners in their think-aloud interview, S1FPE3 and S3FPE3 mentioned Sudoku and Morabaraba, respectively. S3FPE3 and S4FPE3 specified the Tsheretshere and Dibeke games, which cannot be online. S4FPE3 said:

> *"I did not use online teaching. I had to choose between online teaching and Africanised play-based activity. I chose an Africanised play-based activity where learners were playing a Dibeke game"* (S4FPE3).

5.4.3.2 Educators' lived experiences on suitable African play-based activities from the documents

The lesson plans from the educators should have shown the Africanised play-based activities that could be used online to teach mental mathematics to FP learners.

5.4.3.3 Educators' life experiences on suitable African play-based activities from the non-participant observations

The issue of limited technological resources emerged from the observations; in S1FPE3's classroom, they used the Sudoku game physically during the assessment because School 1 has only one smart classroom. At School 2, educators have

smartboards and laptops, and they can access the WI-FI. However, they must know which African activities could be played online to teach mathematics. S2FPE3 used Tsheretshere game. Schools 3 and 4 have online teaching, and their learners have tablets, but the educators need to learn to choose the African play-based activities online to teach their learners mathematics. Figure 5.10 compares educators' experiences on the role of Africanised play-based pedagogy online and suitable African activities to teach FP learners mental mathematics.

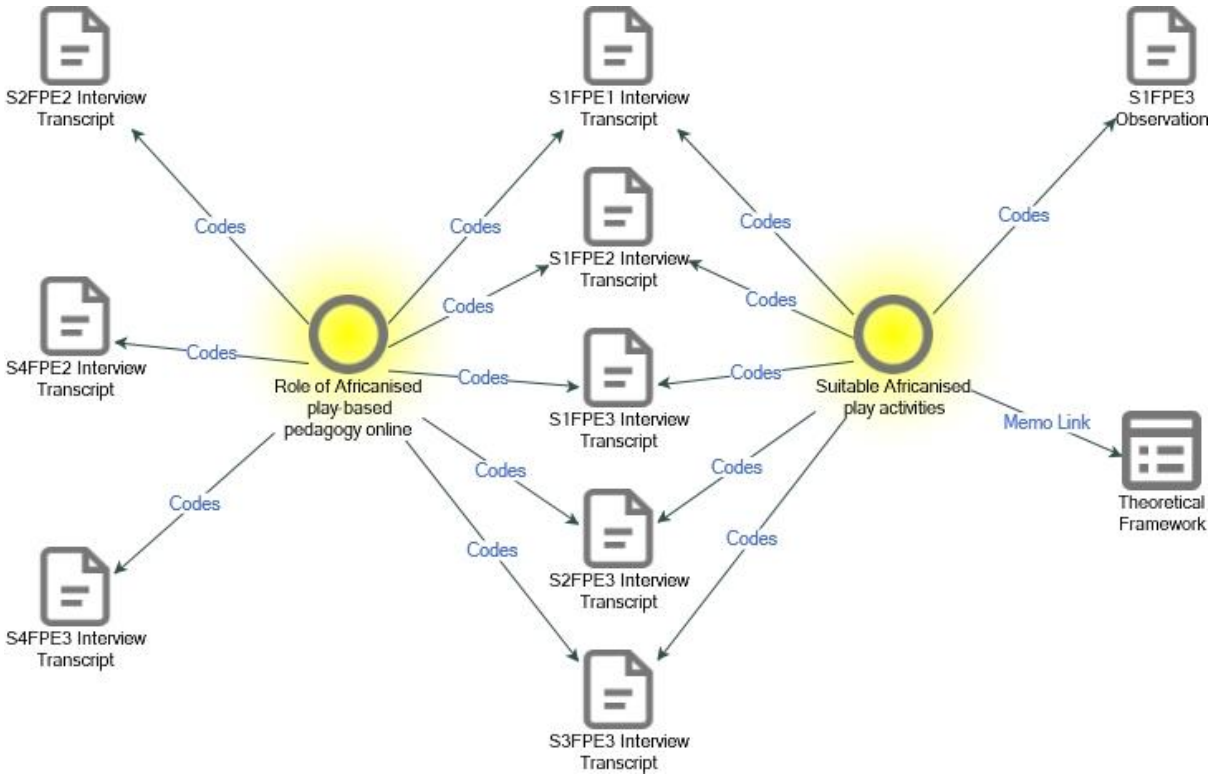


Figure 5.10: Network comparison between the online role of Africanised play-based pedagogies and suitable Africanised play-based activities

The researcher reflected from the lens of the theoretical framework in NVivo to ensure that the theoretical framework still serves as support throughout the study. The researcher compared educators' experiences on the role of Africanised play-based pedagogy in the online teaching of mental mathematics with suitable Africanised play-based activities. Figure 5.11 illustrates that S1FPE1, S1FPE2, S1FPE3, S2FPE3 and S3FPE3 articulated their lived experiences during the interviews on the roles of Africanised play-based pedagogy and suitable Africanised play-based activities that could be used online to teach FP learners. However, only S1FPE3 confirmed that S1 could use African play-based activities even though they did not use them online.

S2FPE2, S4FPE2 and S4FPE3 showed their lived experiences on the role of Africanised play-based activities, but they needed to know which activities to use in the online teaching of mental mathematics. Educators needed to learn how to integrate suitable Africanised play-based activities in the online teaching of mental mathematics to FP learners. The could be a problem with the availability of technological devices for educators and learners to engage in online education.

5.4.4 Legislative Frameworks

Question 4 of this study asked: *What legislative frameworks guide teachers using Africanised play-based pedagogy in the FP?* Question fourteen asked if educators have any legislative framework that guides them on incorporating Africanised play-based pedagogy in the FP to solicit their experiences on this phenomenon. Table 5.5 illustrates the number of coding references and codes per each data set generated from NVivo.

5.4.1.1 The reconstruction of educators' lived experiences on legislative frameworks from the semi-structured interviews

Table 5.5: The number of coding references and codes per interview, documents and non-participant observations

Files	Number of coding references	Number of codes coding
Files\\Document Data\\S1FPE3 Document Data	1	1
Files\\Document Data\\S2FPE3 Document Data	1	1
Files\\Document Data\\S3FPE3 Document Data	1	1
Files\\Document Data\\S4FPE3 Document Data	1	1
Files\\Interview Data\\S1FPE1 Interview Transcript	1	1
Files\\Interview Data\\S1FPE2 Interview Transcript	1	1
Files\\Interview Data\\S1FPE3 Interview Transcript	2	1
Files\\Interview Data\\S2FPE3 Interview Transcript	2	1
Files\\Interview Data\\S3FPE1 Interview Transcript	1	1
Files\\Interview Data\\S3FPE3 Interview Transcript	1	1
Files\\Interview Data\\S4FPE3 Interview Transcript	1	1
Files\\Observation Data\\S1FPE3 Observation	2	1
Files\\Observation Data\\S2FPE3 Observation	1	1
Files\\Observation Data\\S3FPE3 observation	1	1
Files\\Observation Data\\S4FPE3 Observation	2	1

As demonstrated in Table 5.5, the legislative frameworks have been mentioned and analysed in semi-structured interviews, document data and non-participant observations. From S1FPE3 and S2FPE3, there are two reference statements from each educator from the interviews. They also appear from S1FPE3's observations. In addition, the legislative framework is evident from S4FPE3's observations. This

indicates that educators understood the importance of following the legislative framework provided by the DBE in South Africa.

The educators highlighted that, among other frameworks, they were guided by CAPS, ATP and NECT to use Africanised play-based pedagogical practices. However, these policies provide limited guidelines on how educators can use Africanised play-based pedagogies to teach FP learners mental mathematics. S1FPE1 understood that CAPS sometimes guided them in using Africanised play-based pedagogy. S1FPE1 said:

> *"Yes, we have ATP, but the guidelines are limited to Africanised play-based pedagogy. It supports play-based learning in the FP. They do not guide on Africanised play-based pedagogy. I only use this pedagogy when it is mentioned that learners should engage in culturally relevant games. For example, CAPS occasionally states that learners should engage in a card game during mental mathematics. We do not have a policy that guides us on online teaching. In addition, e-learning hasn't been formally launched yet. The tablets we have are not entirely functional"* (S1FPE1).

S1FPE1 said:

> *"Yes, we have ATP, but the guidelines are limited to Africanised play-based pedagogy. It supports play-based learning in the FP. They do not guide on Africanised play-based pedagogy. I only use this pedagogy when it is mentioned that learners should engage in culturally relevant games."*

On the other hand, S3FPE1 exclaimed that there is no alignment between NECT and ATP regarding formal assessments, even though they were both derived from CAPS. S3FPE1

On the other hand, S3FPE1 exclaimed that there is no alignment between NECT and ATP regarding formal assessments, even though they were both derived from CAPS. S3FPE1 said:

> *"Yes. We use NECT, ATP and CAPS in the FP for mathematics. Sometimes, the activities in NECT and ATP do not align. Therefore, we consider ATP. Even for formal assessments, we are advised to ATP"* (S3FPE1).

The findings indicate that educators understood their roles as MKO to be guided by the legislative framework on using Africanised play-based pedagogy in teaching FP learners' mental mathematics. It shows that there are limited play-based activities that integrate culture in teaching and learning mathematics. Furthermore, formal continuous assessments from these frameworks needed to be aligned. As a result, they used ATP for formal evaluations.

The majority of educators – S2FPE1, S2FPE2, S2FPE3, S3FPE2, S3FPE3, S4FPE1, S4FPE2 and S4FPE3 – were clear when they expressed their lived experience that they did not have any policies that guided them on the use of Africanised play-based pedagogy. A follow-up question asked them if they needed the frameworks and where they drew their knowledge from for implementing this pedagogy, especially when teaching mathematics in the FP. They indicated that they were just being creative. They stated:

> *"Our policy does not cover no. Africanised play-based pedagogy and online teaching. I mean CAPS. Including African culture and online teaching merely requires a teacher's inventiveness"* (S2FPE2*).*
>
> *"We don't seem to have them. Intervention programmes introduce these things. However, the CAPS policy does not include that. Our frameworks are, and something like online teaching was introduced recently. Not even to mention play-based pedagogy with an African twist. Maybe there is a revised framework out there that I am unaware of. We draw the knowledge from the internet, and I learned computer skills independently".* (S4FPE2)
>
> *"No. We adhere to CAPS policies. In addition, we have ATP and NECT lesson plans, which we use as a framework for creating our lesson preparations. I must include various teaching methodologies and adhere to the themes as a teacher. I can incorporate culture; however, NECT must be followed in the activities. Even if there is a policy in place, I have never seen it that directs us on how to use online teaching in the FP".* (S3FPE2*)*

5.4.4.2 Educators' lived experiences on the legislative framework from the think-aloud interview sessions

During the think-aloud interviews, the researcher asked educators to describe the workshop, legislative framework, teaching and learning theory/theories or strategies (Question 20). From S1FPE3's perspective, the lesson activities and pedagogies are influenced by teaching and learning theory/theories, legislative frameworks and strategies to teach learners mathematics. S1FPE3 emphasised:

> *"The NECT and Molteno programmes for workshops influenced it. I used the CAPS document. Based on the principles of cognitivism, I use play-based activities to help my learners acquire and process mathematical knowledge. This approach informs my teaching and learning approach. This helps them grow cognitively, which is important for young learners since it helps them learn maths".* (S1FPE3).

This indicates that S1FPE3, with teaching experience of eight years, understood how an FP lesson should be planned and implemented.

On a similar note, S4FPE3 agreed that a lesson should be underpinned by relevant theory/theory, legislative framework and strategies, even though she could not specify which to use in using Africanised play-based pedagogy in teaching mathematics in the FP. S4FPE3 stated,

> "*I integrated policies, strategies and a theory. Because all these things guide teachers, a lesson cannot be developed without these components. It was challenging the first time I had to teach these learners, but I believe that after attending training, teaching and learning were improved. Additionally, you must follow CAPS guidelines. They should be integrated because they can help you become a better teacher. I understood the kinds of learners I teach"* (S4FPE3).

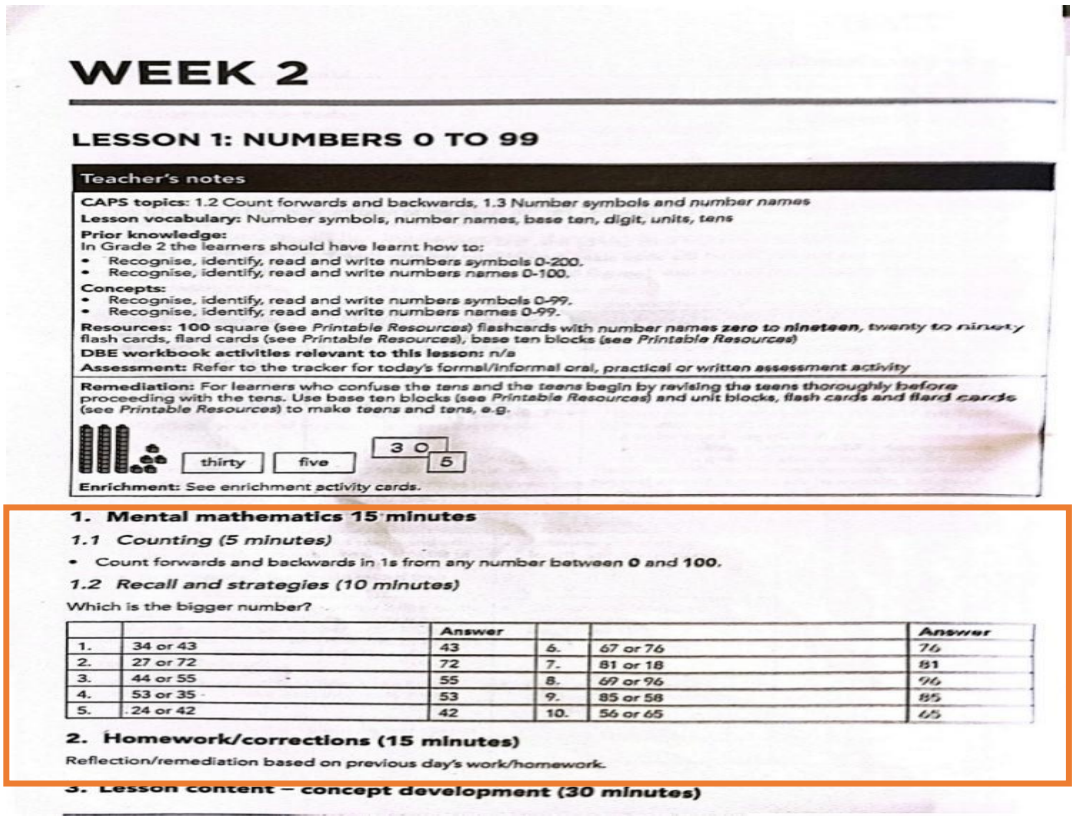
S2FPE3 and S3FPE3 claimed that they lacked knowledge of the necessary legislative framework. A training session was mentioned, though the name had been forgotten. S3FPE3 said:

> *"It was influenced by a training I attended. They were encouraging educators that it is possible to integrate online teaching in the FP and that resources are*

also online. The only thing an educator needs to do is support learners" (S3FPE3).

5.4.4.3 Educators' lived experiences on the legislative framework from the documents

The data from the lesson plans showed that S1FPE3, S2FPE3, S3FPE3 and S4FPE3 used either CAPS, NECT or ATP. All four Grade 3 educators used the frameworks mentioned in their teaching and learning activities. Figure 5.11 illustrates the lesson from NECT from which educators drew their knowledge.



WEEK 2

LESSON 1: NUMBERS 0 TO 99

Teacher's notes

CAPS topics: 1.2 Count forwards and backwards, 1.3 Number symbols and number names

Lesson vocabulary: Number symbols, number names, base ten, digit, units, tens

Prior knowledge:
In Grade 2 the learners should have learnt how to:
- Recognise, identify, read and write numbers symbols 0-200.
- Recognise, identify, read and write numbers names 0-100.

Concepts:
- Recognise, identify, read and write numbers symbols 0-99.
- Recognise, identify, read and write numbers names 0-99.

Resources: 100 square (see *Printable Resources*) flashcards with number names **zero to nineteen**, twenty to ninety flash cards, flard cards (see *Printable Resources*), base ten blocks (see *Printable Resources*)

DBE workbook activities relevant to this lesson: n/a

Assessment: Refer to the tracker for today's formal/informal oral, practical or written assessment activity

Remediation: For learners who confuse the tens and the teens begin by revising the teens thoroughly before proceeding with the tens. Use base ten blocks (see *Printable Resources*) and unit blocks, flash cards and flard cards (see *Printable Resources*) to make teens and tens, e.g.

Enrichment: See enrichment activity cards.

1. Mental mathematics 15 minutes

1.1 Counting (5 minutes)

- Count forwards and backwards in 1s from any number between **0** and **100**.

1.2 Recall and strategies (10 minutes)

Which is the bigger number?

		Answer			Answer
1.	34 or 43	43	6.	67 or 76	76
2.	27 or 72	72	7.	81 or 18	81
3.	44 or 55	55	8.	69 or 96	96
4.	53 or 35	53	9.	85 or 58	85
5.	24 or 42	42	10.	56 or 65	65

2. Homework/corrections (15 minutes)

Reflection/remediation based on previous day's work/homework.

3. Lesson content – concept development (30 minutes)

Figure 5.11: A copy of a lesson from NECT

Figure 5.11 shows a copy of the lesson plan from NECT that guides educators on using Africanised play-based pedagogy in teaching mental mathematics. NECT for Week 1 needs to train educators on using Africanised play-based pedagogy in teaching mental mathematics. Mental mathematics activities are divided into counting forward and backward (5 minutes) and recalling and strategies (10 minutes).

5.4.4.4 Educators' lived experiences on the legislative framework from non-participant observations

The observations confirmed that educators use CAPS, NECT or ATP to guide lesson planning and implementation. S1FPE3 referred to NECT in her lesson implementation. However, S1FPE3 used a Sudoku game, which was not derived from any legislative framework; this could be part of the inventiveness the educators were talking about. S2FPE3, S3FPE3 and S4FPE3 referred to NECT and ATP to formulate their lessons. As such, S2FPE3 did not implement Africanised play-based pedagogy in the classroom. The findings signify that educators are limited to legislative frameworks that guide them in using Africanised play-based pedagogy in teaching mathematics since CAPS, NECT and ATP are outdated and limit this pedagogical approach in the FP of teaching and learning mathematics.

5.4.5 Educators Strategies

Question 5 was about the strategies educators used to support learners when using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. The theoretical lens, such as the role of MKO and integration of Africanised play-based pedagogy in teaching and learning mathematics, links to strategies educators use when using Africanised play-based pedagogy in online teaching of mental mathematics to FP learners. From three data sets, the findings on the methods for using Africanised play-based pedagogy emerged mainly from the interviews. Figure 5.13 shows a sunburst of educators' strategies to support Africanised play-based pedagogy in the online teaching of mental mathematics generated from NVivo.

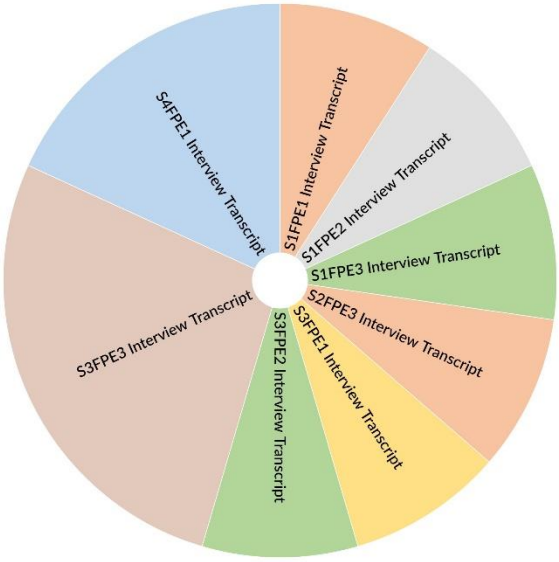


Figure 5.12: Educators' strategies to support Africanised play-based pedagogy in the online teaching of mental mathematics

Figure 5.12 displays the lived experiences of educators on strategies that supported them in using Africanised play-based pedagogy in the online teaching of mental mathematics that emerged from the semi-structured interviews. S3FPE3 and S4FPE1 had the most experiential reference statements. Since the sunburst chart displayed the same colour, S1FPE3 and S3FPE2 discussed comparable strategies. S1FPE1 and S2FPE3 may have equivalent opinions and insights regarding the phenomenon.

5.4.5.1 The reconstructions of educators' lived experiences on strategies that support Africanised play-based pedagogy in online mathematics teaching

To solicit the lived experiences of educators, Question 15 from the interview schedule asked educators if they had any strategies they followed when using Africanised play-based pedagogy in the online teaching of mental mathematics in the FP. The findings showed that educators needed strategies that link Africanised play-based pedagogy to the online teaching of mathematics in the FP. Most of their views and perceptions were based on online teaching and teaching and learning of mathematics in the FP. Most educators indicated that their strategies were the guidelines from Six Bricks[5]. In particular, S2FPE2, S2FPE3, S4FPE1 and S4FPE3 used Six Bricks as a strategy to

[5] Six Bricks is one of the LEGO Foundation's tools to introduce learning through play into different settings. Through fun, short and playful activities with sets of LEGO® DUPLO® bricks in six bright colours, children practice a range of skills (The Lego Foundation)

use Africanised play-based pedagogy online. In addition, S2FPE2 explained the guidelines from Six Bricks, mentioning coding and robotics in teaching and learning mathematics in the FP. S2FPE3 said:

> "*Yes. I have been to the Six Bricks workshop. They gave us lessons in coding, robotics and online teaching. It was merely an overview of how to apply them in the educational setting. They provided teachers' manuals and learners with Lego bricks. Not the department, but an NGO organised it. They chose a few schools in our cluster".* (S2FPE3)

The most common finding from the educators' lived experiences on the strategies of Africanised play-based pedagogy in teaching mathematics to FP learners was that more was needed. S1FPE3 and S3FPE2 supported this. S3FPE2 explained:

> *"Yes. We do attend training even though it is not more frequent. I just forget some of the strategies that we can use. This could be caused by not attending them regularly. Kahoot, Coding robotics and a project-based teacher connection taught us about teaching and learning mathematics from grades R to 12. For online teaching, we are trained by other educators"* (S3FPE2).

Using Kahoot was brought up again by S3FPE2 as one of the strategies for implementing mathematics in online teaching.

In the same breath, S1FPE1 and S2FPE3 explained that the knowledge they received from the intervention programmes was inadequate. They stated:

> *"Indeed, we have participated in coding and robotics seminars. It was SADTU that organised the workshop. Educators were only being introduced to it. The workshop did not fully fulfil our understanding of incorporating robotics and coding into teaching and learning activities. Although they indicated that we could use games, they did not address how we might use them online"* (S1FPE1).

> "*Yes. I have been to the Six Bricks workshop. They gave us lessons in coding, robotics and online teaching. It was merely an overview of how to apply them in the educational setting. They provided teachers' manuals and learners with*

Lego bricks. Not the department, but an NGO organised it. They chose a few schools in our cluster" (S2FPE3).

Even though the Six Bricks intervention guidelines do not integrate Africanised play-based pedagogy, they could be used in teaching mathematics online to FP learners.

5.4.5.2 Educators' lived experiences on strategies that support Africanised play-based pedagogy in the online teaching of mathematics from think-aloud interviews

The educators were asked Question 20, combined with the legislative frameworks they use to integrate Africanised play-based pedagogy. All four Grade 3 educators focused on the legislative frameworks rather than strategies. S3FPE3 attempted to mention the strategies that support the lesson; however, because they do not frequently attend these workshops, the name of the strategy needed to be provided.

"It was influenced by a training that I have attended. They were encouraging educators that it is possible to integrate online teaching in the FP and that resources are also online. The only thing an educator needs to do is support learners" (S3FPE3).

In S3FPE3's discussion, the role of the MKO was mentioned. They supported learners in developing mathematical skills.

5.4.5.3 Educators' lived experiences on strategies that support Africanised play-based pedagogy in online mathematics teaching from the documents

There needs to be evidence from the lesson plans of educators' lived experiences on strategies that support Africanised play-based pedagogy in online mathematics teaching. S1FPE3 educators mentioned during the interviews that they did not have a strategy that guided them on using Africanised play-based pedagogy in the online teaching of mental mathematics activities. Even though S2FPE3, S3FPE3 and S4FPE3 spoke about Six Bricks' strategies during the interviews, they needed more guidelines to use them in their lesson planning.

5.4.5.4 Educators' strategies for Africanised play-based pedagogy in online mathematics teaching insights from non-participant observations

The observation validated that educators needed strategies to support them in using Africanised play-based pedagogy in online mathematics teaching to FP learners. Consequently, they referred to the legislative framework that guided them on using Africanised play-based pedagogy in teaching mathematics to FP learners. During the lessons, educators referred to CAPS, NECT and ATP in teaching and learning mental mathematics. Consequently, the findings showed that educators use the Six Bricks strategies to guide them in using online teaching through coding and robotics in teaching and learning mathematics to FP learners, even though they were inadequately trained.

5.5 DISCUSSION OF FINDINGS

Following the model of Smith et al. (2022), the researcher grouped PETs to create Group Experiential Themes (GETs) for educators to discuss the findings. The study explored the use of Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. The PETS from Table 5.4 presentation of findings are used to create GETs aligned with the study's objectives. Table 5.6 summarises the relationship between the themes and the study objectives.

Table 5.6: The study objectives linked to the emerged themes

Objectives	Emerging theme
1. To explore the use of Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners	Theme 1: The use of online teaching platforms to integrate Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners
2. To understand the role of Africanised play-based in the online teaching of mental mathematics to FP learners	Theme 2: The role of Africanised play-based in developing learners' problem-solving skills and mathematical skills in the online teaching of mental mathematics to FP learners

Objectives	Emerging theme
3. To identify suitable Africanised play-based activities in the online teaching of mental mathematics to FP learners	Theme 3: Suitable Africanised play-based activities in the online teaching of mental mathematics to enhance ZPD to FP learners
4. To identify and understand the legislative frameworks guiding the use of Africanised play-based pedagogy in the FP of teaching	Theme 4: Legislative frameworks guiding the use of Africanised play-based pedagogy in the FP of teaching
5. To investigate support strategies that educators can use during Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners	Theme 5: The role of MKO in using strategies that support educators in using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners

Table 5.3 illustrates that the five themes that emerged from the data analysis were grouped according to their relationship to the objectives of this study. It should be noted that the themes were also linked to categories used to present the findings in the previous section. The first theme emerged from educators' lived experiences using online teaching platforms to integrate Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. Theme 2 emerged from educators' lived experiences on the role of Africanised play-based learning in developing learners' problem-solving and mathematical skills in the online teaching of mental mathematics to FP learners. Furthermore, Theme 3 emerged from suitable Africanised play-based activities in the online teaching of mental mathematics to enhance the cognitive development for FP learners. Theme 4 emerged from the legislative frameworks guiding the use of Africanised play-based pedagogy in the foundation teaching phase. Lastly, Theme 5 emerged from the role of MKO in using strategies that support educators in using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners.

5.5.1 Theme 1: The Use of Online Teaching Platforms

Earlier in this study (Section 1, Chapter 1), it was indicated that the DBE (2011) encourages educators to include Africanised activities in teaching mathematics in the

FP. Additionally, Owusu and Obuo Addo (2023) stressed that play-based pedagogies should be included in teaching mathematics to young learners, among other cultural activities. On the same note, it was affirmed that Africanised play-based pedagogy must also be used in teaching mental mathematics to FP learners (Umbara et al., 2021). In addition to Umbara et al. (2021), Ali (2020) provided that this pedagogy, including but not limited to mathematics lesson planning, implementation and assessments, could be used in online teaching to FP learners.

This study asked: *How can Africanised play-based pedagogy be used in the online teaching of mental mathematics to FP learners*? The theoretical framework underpinning this study explains that the educator's role as the MKO is to integrate Africanised play-based pedagogy in teaching and learning mathematics in the FP. Even though the use of ethnomathematics is stipulated in the CAPS policy, how educators can use it to teach mathematics needs to be clarified. The reviewed literature from different regions, including South Africa, indicated that educators could employ Africanised digital games to teach FP learners mental mathematics online. This is supported by Oluwatayo, Anyikwa and Obidike (2020), who stated that since educators lacked time for game-based learning in teaching mathematics, they could use Africanised digital games. Golafshani (2023) stated that indigenous storytelling could also teach mathematical concepts related to their own real-world experiences. The literature shows that digital games that incorporate culture and cultural storytelling that can be demonstrated online through technological platforms can be used to teach mental mathematics to foundation-activated learners.

The findings of this study revealed that FP educators need more experience and knowledge on the use of Africanised play-based pedagogy. They showed confidence in teaching mental mathematics to FP learners, as it is part of CAPS policy. Firstly, educators raised the challenge of the lack of technological devices to use Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. Learners from S1 had tablets from Grades 1 to 3. However, educators did not have individual laptops, and the school shared only one smart classroom. Learners from S2 did not have tablets, but they had access to a computer laboratory. The educators from this school had laptops; each class had a smartboard, while every building block had a hub.

When asked a probing question during the interviews about where they acquired knowledge of online teaching platforms in the FP, S2FPE2 replied:

> *"Our principal is technologically advanced. He had/has a friendship with a certain private school in Polokwane. He saw the necessity of these technological devices at our school. We were using chalkboards first, followed by whiteboards and interactive whiteboards, and most recently, we used smartboards. Interactive whiteboards are more like smartboards, and they are not technologically advanced. They were not sponsors but used the funds allocated for the COVID-19 pandemic by the DBE. Although my class uses the computer labs frequently, we can access them"* (S2FPE2).

They can access the school WI-FI in their classrooms. S3 learners had tablets even though they were limited; their school had projectors, and educators had laptops. Learners from S4 had tablets, but they were limited; the educators could not access the school's WI-FI.

Even though some educators could access online teaching platforms, the second challenge in using Africanised play-based pedagogy in teaching mental mathematics to FP learners was to select relevant digital play-based activities. The educators knew they could search for Africanised play-based pedagogy online through YouTube, Google, Web-Videos and Tiktok. However, they needed help finding what is relevant in teaching mental mathematics to FP learners. This indicates that knowledge of digital games and storytelling that integrate culture is required.

The interviews further showed that educators from S3 and S4 knew how to use Kahoot as an online teaching platform to teach learners mathematics. It was mentioned that they collaborated with the parents and surrounding schools in their circuit to give learners assessments through Kahoot. However, they use Kahoot during competitions only because of the limited number of tablets available to learners. The assessments that they design need to incorporate play-based pedagogy. S2FPE2 discussed that their school does not use Kahoot, but she knows it as a parent.

S1FPE3 and S3FPE3 mentioned some Africanised play-based activities that could be used in the online teaching of mental mathematics to FP learners during the think-

aloud interviews. Even though these games could be played online, the educators explained that they would use various technological platforms to demonstrate these games for learners, who would later play them physically. S2FPE3 and S4FPE3 imagined how they would play videos of learners playing Tsheretshere and Dibeke games, and they would further request learners to go outside to play them physically during mental mathematics.

The copies of the lesson plans supported the idea that educators needed more knowledge on how to use Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. Furthermore, their lesson plan templates needed to be more satisfactory. Their lesson plan templates do not have a clause for teaching pedagogies, the aim of the lesson, assessment activities and tools. Figure 5.13 presents a snapshot of the PPT from S2FPE3's classroom displayed on the smartboard.

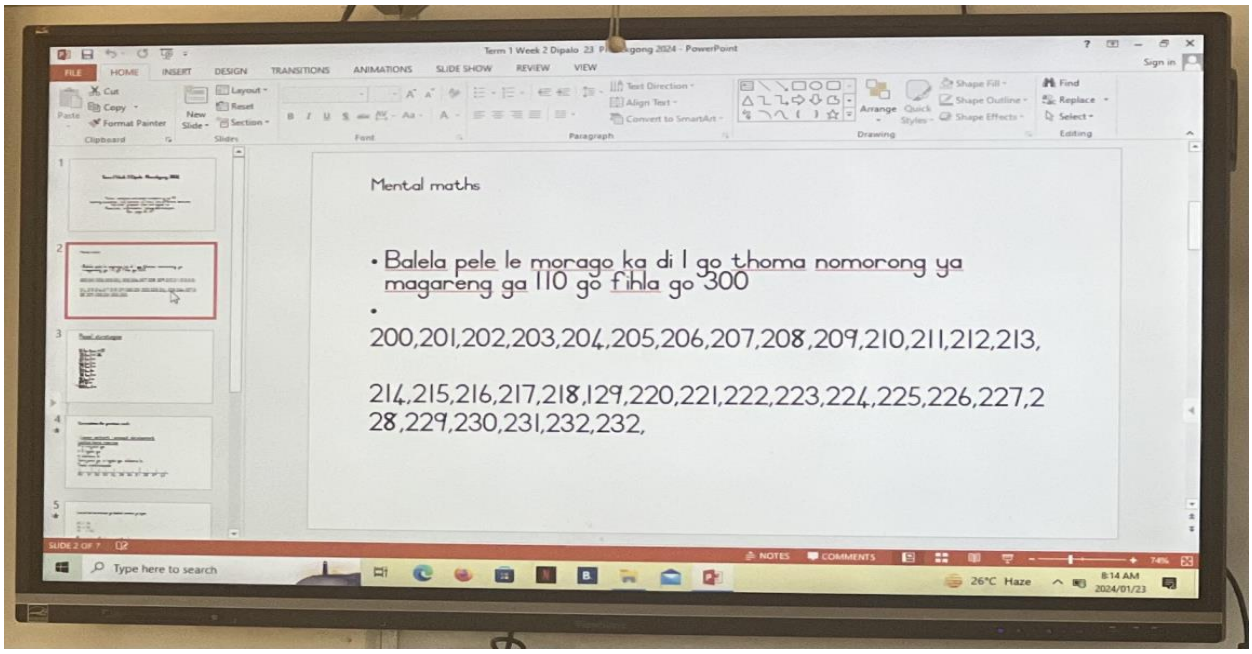


Figure 5.13: A snapshot of PPT from S2FPE3's classroom

Figure 5.13 displays a snapshot of the PPT from S2FPE3's classroom, which also served as a lesson plan. It shows that learners counted backward and forward for mental mathematics activities in ones from 110 to 300. The PPT does not include Africanised play-based pedagogy even though the educators have used online teaching platforms.

The non-participant observations validated that educators' knowledge and experience in using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners is limited. The educators used counting backward and forward methods during mental mathematics. Only S1FPE3 used a Sudoku game as an assessment. However, they did not play the game online. Figure 5.14 exhibits a copy of the learner's activity book from S1FPE3's classroom.

Figure 5.14: A copy of the learner's activity book from S1FPE3's classroom

Figure 5.14 shows that most learners got full marks for the assessment. This could mean that even though the learners did not play the game online, they could develop mathematical counting skills by playing Sudoku using pen- and-paper representations.

It was fundamental for educators to reflect on their lessons by participating in stimulated recall interview sessions. S1FPE3 clarified that there was a time constraint for teaching mental mathematics because she only had five minutes to spare, despite NECT lesson plans directing educators to spend 15 minutes on mental mathematics in the FP. This suggests that educators still required additional training in designing and implementing mental mathematics activities. According to S2FPE3 and S3FPE3, lessons were delivered as expected. Taking a contrary stance, S4FPE3 claimed that the lack of technology tools prevented Africanised play-based pedagogy from being applied online. Therefore, this study's findings highlight that educators could not teach learners mental mathematics through digital games that integrate African culture.

5.5.2 Theme 2: The Role of Africanised Play-based Activities

Based on the reviewed literature, a knowledge gap was found on the role of Africanised play-based teaching in the online teaching of mental mathematics to FP learners in Chapter 3, Section 3.3.1. Thus, this study asked: *What role does Africanised play-based pedagogy play in the online teaching of mental mathematics to FP learners?* The literature showed that the role of cultural activities in teaching and learning mathematics is to develop learners' problem-solving skills. Additionally, for learners to fully develop this skill, an MKO is required (Matsekoleng et al., 2024). Russo et al. (2021) proposed that playing digital games that combine African culture assists in developing the problem-solving skills necessary for learning mathematics. In the same vein, Chirinda (2021), Lunga et al. (2022), and Matsekoleng et al. (2024) affirmed that the role of Africanised play-based pedagogy in mathematics education is to improve learners' problem-solving skills.

This study found that Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners is to develop their problem-solving and mathematical skills, such as counting skills. S1FPE1 and S2FPE3 clarified that their role is to help learners build their ability to solve mathematical problems. S2FPE1, S2FPE3, S3FPE1, S3FPE3 and S1FPE2 explained that for learners to solve mathematical problems, they need to have a sense of counting skills. They also develop counting skills because mental mathematics activities usually require learners to count backward and forward. The development of counting skills was mentioned again by S1FPE1, S2FPE1, S2FPE2, S2FPE3 and S3FPE1 about the role of African games. As a result, findings indicated that the role of Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners is to develop learners' counting skills.

The think-aloud interviews with S1FPE3 and S3FPE3 revealed that digital games such as Morabaraba and Sudoku enhance learners' problem-solving skills in teaching mathematics. S2FPE3 and S4FPE3 added that they could improve learners' mathematical, critical thinking and counting skills.

However, educators' copies of lesson plans must demonstrate the role of Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners.

Hence, the study revealed that educators' lesson planning could be more satisfactory. Even though S3FPE3 planned a lesson on a government website, with available digital resources, the role of Africanised play-based pedagogy in online teaching still needed to be demonstrated. Figure 5.15 illustrates a snapshot of planned activities that could be used online in teaching mathematics from S3FPE3.

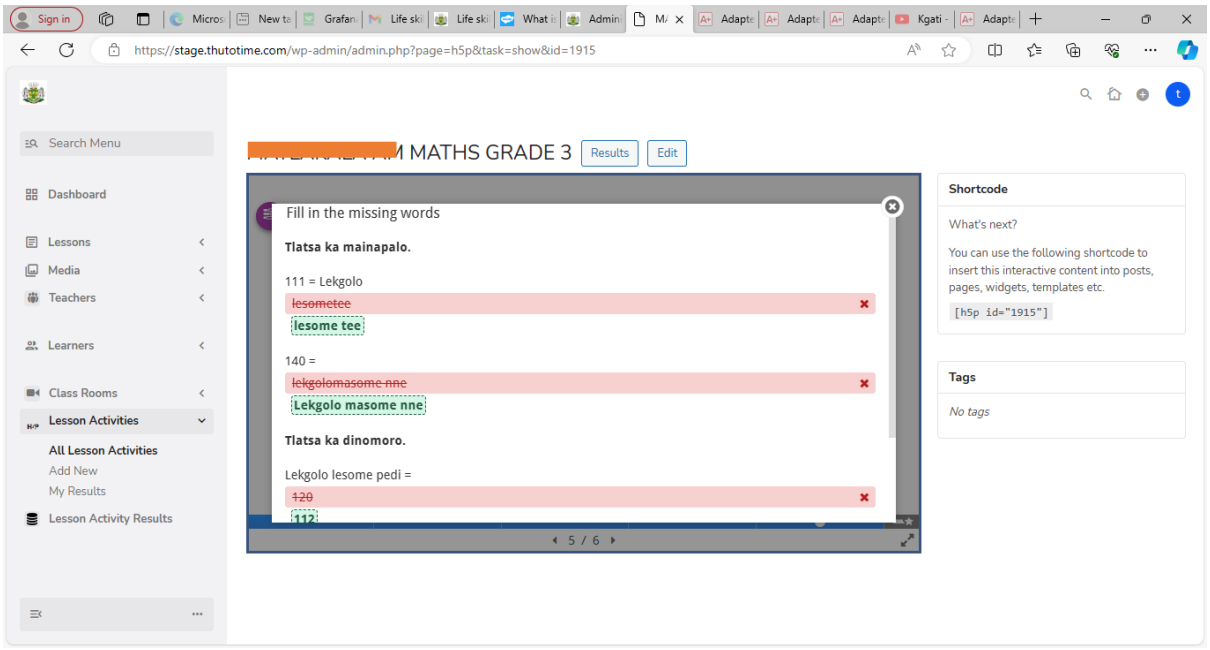


Figure 5.15: A snapshot of lesson activities from S3FPE3

Figure 5.15 shows planned activities for learners. The snapshot shows that S3FPE3 could plan and implement the mathematics lesson and assess the FP learners online from the DBE government website using Thutotime. Figure 5.15 further shows the media where educators can find digital play-based activities to teach mathematics in the FP.

However, non-participant observation demonstrated that learners' problem-solving skills needed development. Educators should have used Africanised play-based pedagogy in online mathematics teaching to FP learners. Figure 5.16 illustrates a snapshot of the learners' activity book from S3FPE3.

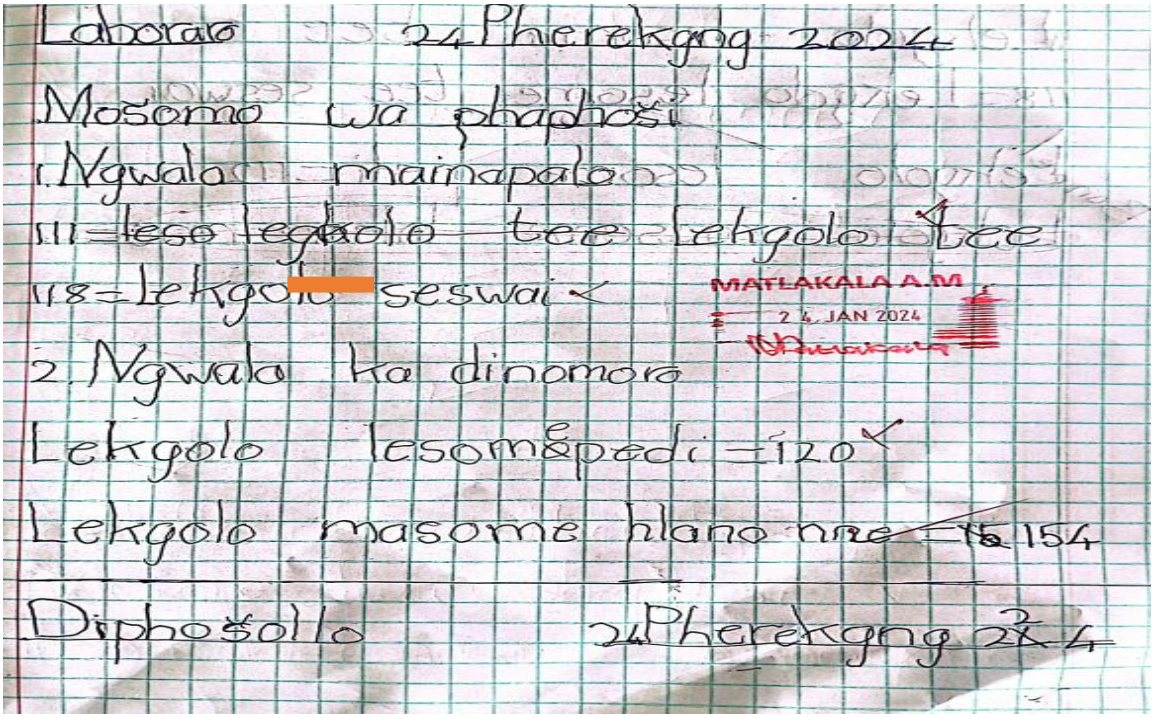


Figure 5.16: A snapshot of the learners' activity book from S3FPE3

Figure 5.16 shows that learners got lower marks even though the educators displayed a video of children playing the Diketo game. Learners in S3FPE3's classroom were allowed to play the game physically. However, the play-based activities needed to align with the videos displayed and the mathematical concepts underpinned.

Africanised play-based pedagogy plays an essential role in the online teaching of mental mathematics to FP learners by developing their mathematical and problem-solving skills, according to the findings from stimulated recall interviews S1FPE3, S2FPE3 and S3FPE3. S4FPE3 clarified that although a play-based pedagogy was not employed, learners acquired counting skills during mental mathematics. Consequently, this study reveals that Africanised play-based pedagogy in the online teaching of mental mathematics helps FP learners to strengthen their problem-solving and mathematical skills.

5.5.3 Theme 3: Suitable Africanised Play-Based Activities

This study asked: What are suitable African play-based activities for the online teaching of mental mathematics to FP learners? *To identify suitable Africanised play-based activities in the online teaching of mental mathematics to FP learners,* the

reviewed literature focused on digital games such as Morabaraba, Ludo and Math Zap card in the online teaching of mathematics. The literature indicated that educators could use suitable Africanised play-based activities in the online teaching of mental mathematics to enhance the ZPD of FP learners.

From Section 3.4, Mosimege (2020) and Tachie and Galawe (2021) demonstrated how playing Morabaraba helped learners gain counting skills from online. In addition, they get better at solving problems when they plan – from getting stuck to moving their cows when playing the game. In keeping with that perspective, Abdullah (2022) explained that teachers can use Morabaraba online to allow learners to play in pairs by sharing their computer screens. Sumadi, Kusmayadi and Fitriana (2022) asserted that learners who play Ludo online improve their ability to solve mathematical problems. Rasid, Nasir, Singh, Han and Sueb (2022) declared that by playing card games online, educators might have an excellent opportunity to establish and foster social communication with learners about numerical relationships. The researcher concurred with these scholars that it is the role of the educator (as MKO) to expand learners' problem-solving skills by using the appropriate play-based activities to enhance their ZPD.

Educators have lived experiences using digital games incorporating African culture to expand learners' mental mathematics skills through the ZPD. S1FPE2 and S2FPE3 discussed card games. S3FPE3 explained that Morabaraba and Sudoku may be used. Playing Sudoku could help learners learn mental mathematics, according to S4PFE2. Last, S1FPE1 discussed how the Ludo game could improve students' counting, decision-making and problem-solving skills.

The researcher identified the following suitable Africanised play-based activities, such as dice, cards, Ludo, Morabaraba and Sudoku games, that educators used to enhance the ZPD in their roles and how educators could use them in the online teaching of mental mathematics. All these Africanised play-based games could be used in the online teaching of mental mathematics to FP learners. Table 5.7 provides suitable Africanised play-based activities, their roles and how educators can use them to teach mental mathematics to FP learners.

Table 5.7: Suitable Africanised play-based activities and their roles in teaching mental mathematics online

Suitable Africanised play-based activities	The role of each play activity in teaching mental mathematics	How educators can use each play activity to teach learners mental mathematics
1. Dice	Counting and addition skills	By understanding Abdullah (2022), educators can allow learners to play in pairs by sharing their screens when using technological devices
2. Cards	Problem-solving skills	
3. Ludo	Counting, problem-solving and decision-making skills	
4. Morabaraba	Mathematical skills	
5. Sudoku	Decision-making, mathematical thinking and problem-solving skills	

Table 5.7 demonstrates that different suitable Africanised play-based pedagogies could be used in the online teaching of mental mathematics to FP learners. Column 1 shows suitable Africanised play-based activities; column 2 explains the roles of playing each game online. The last column (3), concerning the reviewed literature, describes how educators can use these digital games in online teaching of mental mathematics to FP learners.

Even though educators understood the roles of Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners, most still needed to select suitable Africanised play-based activities in planning and implementing the lessons. There must be evidence of the selection of Africanised play-based activities from educators' lesson plans that could be used online. Only S1FPE3 was able to employ Sudoku in teaching and learning activities from the non-participant observations.

Therefore, this study's findings indicate an integration of the MKO and the ZPD in using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. Furthermore, the study identified games such as Dice, Math Zap Cards, Ludo, Morabaraba and Sudoku as suitable Africanised play-based activities in the online teaching mental mathematics to FP learners.

5.5.4 Theme 4: Legislative Frameworks

This section discusses the legislative frameworks that guided teachers using Africanised play-based pedagogy in the FP. *To identify and understand the legislative frameworks guiding the use of Africanised play-based pedagogy in the FP of teaching,* the researcher compared the legislative frameworks in South Africa's curriculum with those of other international countries regarding the use of Africanised play-based pedagogy in the FP of teaching in Section 3.5, Chapter 2.

The literature showed that legislative frameworks emphasise using play-based pedagogy in the FP of teaching from different regions. UNICEF (2022) showed that play-based teaching requires educators to consider cultural circumstances. The New Zealand curriculum highlights that the theoretical assumptions of sociocultural theory and play-based activities should be integrated into teaching and learning languages and mathematics in the early years (Westbrook & Hunkin, 2020). In addition, England's curriculum in ECE encourages educators to use differentiated learning, and cultural activities should be combined with learning through play (Corral-Granados et al., 2023). Similarly, the DBE (2011) encourages FP educators to use the components of ethnomathematics in teaching and learning mathematics to FP learners. The theoretical framework showed that educators (MKOs) should use legislative frameworks in teaching and learning in the FP. Nevertheless, there needs to be more transparency in the guidelines these legislative frameworks provide regarding integrating play-based pedagogy and cultural perspectives for teaching and learning.

This study found that the ATP, NECT and CAPS are guidelines for using Africanised play-based pedagogy in teaching. NECT and ATP policies were created in response to the COVID-19 pandemic and are based on the CAPS document. S1FPE1 mentioned that the guidelines from CAPS are limited regarding Africanised play-based pedagogy. As such, the guidelines primarily focus on play-based pedagogies. However, even though both NECT and ATP were generated from CAPS, S3FPE1 declared that there needed to be alignment between them concerning formal assessments. During the interviews, S4FPE3 was asked a probing question about any framework that supported play-based learning in teaching mathematics in the FP. S4FPE3 expressed:

"Yes. The CAPS policy does not specifically state which play-based activities should be used for which lessons. I would demonstrate what I mean if I had it with me. For instance, in our session today, we discussed mentally calculating numbers by counting forward and backward. Is that considered play? Although they occasionally state that learners should play cards, they never clarify how. It depends on the teacher's creativity. Teaching these young children requires constant pleasure and curiosity" (S4FPE3).

Educators' lesson plans show that they planned their activities guided by CAPS, NECT and ATP. The non-participant observations also indicated that educators who participated in this study referred to CAPS, NECT and ATP. The findings suggest that the legislative frameworks need to be updated and updated, and the guidelines need to be transparent to educators when using either Africanised play-based or play-based pedagogy.

5.5.5 Theme 5: The Role of the MKO

Section 3.6 identified that there needs to be more reliable evidence on the strategies that support educators in using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. As such, the researcher reviewed strategies that integrate online teaching in the early years. Strategies that enhance problem-solving skills, including assessment, developmentally appropriate practices and stakeholder collaboration were discussed. Firstly, Dai et al. (2023) and Mbhiza (2021) emphasised that Africanised games such as Morabaraba and Ludo can enhance learners' problem-solving and cognitive skills. Secondly, Pyle et al. (2022) and Kaimar et al. (2022) asserted that a strategy to improve learners' mathematical skills is to incorporate play into the assessment. Thirdly, Brottman et al. (2020) demonstrated how integrating digital games with a twist of culture promotes diversity. Lastly, Bhattacharya et al. (2019)encouraged educators to monitor their children's technological devices and support them in playing appropriate digital games to learn mathematics skills.

The participants used the strategies of the Six Bricks intervention programme. Educators from S2, S3 and S4 attended a training on Six Bricks. They were provided with educators' guides and learners with six Lego bricks. The strategies focus on play-

based pedagogy and an introduction of coding and robotics in the FP. However, it was recently introduced, and they only attended the workshops occasionally. S3FPE2 explained:

> *"Yes. We do attend training even though it is rare. I just need to remember some of the strategies that we can use. This could be caused by not attending them regularly."*

Some educators from S1 participated in a workshop about implementing coding and robotics in the FP. They also mentioned that they attended it once.

The findings of this study support the idea that educators used strategies to help them in using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners as they use the strategy of Six Bricks that guided them in using play-based pedagogy and online teaching. This strategy also encouraged them to use coding and robotics in teaching and learning mathematics in the FP. Play-based pedagogy is mentioned in some of the activities. In addition, coding and robotics have yet to be used online. They practise it physically using the Lego bricks. The guidelines on the use of coding and robotics are shown in Figure 5.17.

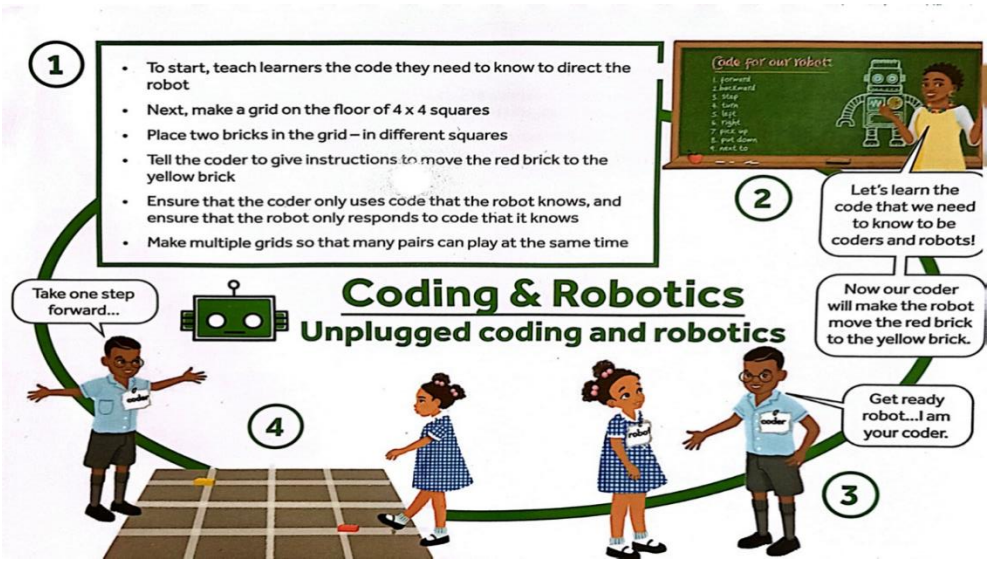


Figure 5.17: Guidelines on coding and robotics from Six Bricks strategies

It appears from Figure 5.17 that educators are provided with step-by-step instructions on incorporating robotics and coding into math lessons. Revised guidelines on using coding and robotics in teaching mathematics step-by-step could assist educators in

teaching mental mathematics. On the other hand, there are no online instructions for using robotics and coding. These ideas are not available to educators for lesson planning and implementation.

5.6 CHAPTER SUMMARY

An interpretative phenomenological analysis and interpretation of qualitative data obtained from semi-structured interviews, document analysis and non-participant observations were provided in this chapter. Additionally, through themes that emerged, the chapter discussed data preparation and the presentation and discussion of findings. The summary, conclusions and recommendations will be derived from the combined interpretative analysis in the next chapter. Chapter 6 presents the conclusions that were derived from the findings.

CHAPTER 6: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 INTRODUCTION

The preceding chapter presented the use of IPA in determining the study's findings. The study's findings are also discussed through the emerging themes that align with the research objectives. This chapter summarised the findings against the theoretical framework and related literature reviewed in Chapter 2 to enlighten educators about using Africanised play-based pedagogy in the online teaching of mental mathematics to enhance FP learners' problem-solving, mathematical and counting skills. In addition, this chapter concludes by answering all the research questions from Section 3.1. Later, the researcher acknowledges the study's limitations and guidelines and offers recommendations.

6.2 SUMMARY OF RESEARCH FINDINGS

This section has two sub-sections (A and B), where Section A discusses the scholarly findings from the related literature reviewed in Chapter 3 in the context of the theoretical framework. Firstly, the researcher provided a comprehensive summary of the theoretical framework because it served as a significant foundation for the data analysis in this study. Among other reasons, the role of the theoretical framework in this study was to support or contradict the research findings, making the recommendations and conclusions of this study (Kivunja, 2018). Section B discusses the empirical results from the participants in connection with the literature reviewed in Chapter 3. Again, the researcher summarises the literature review of this study and discusses how the findings support or contradict the previous research.

6.2.1 Section A: Key Scholarly Findings

It is evident in Chapter 2 of this study that the theoretical framework underpinning this study was formed by two theories: Ethnomathematics and Vygotsky's sociocultural theory. The use of the theoretical framework mentioned in Section 2.2 explained how these two theories influenced the aim of this study: *Exploring the use of Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners* in Section 3.2.

After discussing these two theories, the study found that they aligned with using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners (Section 2.2-2.4). From the perspectives of ethnomathematics theory, Rosa and Orey (2016) contend that six essential dimensions – cognitive, conceptual, educational, epistemological, historical and political – examine the sociocultural foundations of mathematical knowledge, and they support educators in teaching mathematics (Section 2.2.1). These dimensions necessitate the incorporation of cultural activities in teaching mathematics.

6.2.1.1 The role of cultural activities in teaching mental mathematics

Section 2.2.1 emphasises that the role of cultural activities in teaching and learning mathematics is to develop learners' problem-solving skills (Acharya et al., 2021; Brandt & Chernoff, 2015; Rosa & Orey, 2016). In the same vein, Nur et al. (2020) concur that mathematics educators must include cultural activities in their lesson plans to improve learners' problem-solving skills.

The findings of this study indicated that Africanised play-based pedagogy in the online teaching of mental mathematics aims at developing learners' problem-solving, mathematical and counting skills, as revealed in Section 5.5.2, Chapter 5. There is evidence from S1FPE1, S2FPE1, S2FPE2, S2FPE3 and S3FPE1 that the role of African games in teaching mental mathematics is to develop learners' counting skills. The evidence exposes educators to the importance of integrating Africanised play-based pedagogy in teaching mathematics. The following section discusses the importance of Africanised play-based pedagogy.

6.2.1.2 The significance of Africanised play-based pedagogy in teaching mental mathematics online

As outlined in Section 2.2.2, the significance of integrating Africanised play-based pedagogy in teaching and learning mathematics is to develop learners' problem-solving skills (Moloi et al., 2021). Furthermore, Mosimege (2020) agrees that playing African games enables learners to connect learning mathematics in the classroom to circumstances in their real-life contexts. Mania and Alam (2021) supported this viewpoint, stating that educators must integrate ethnomathematics into their lessons to help learners improve their mathematical problem-solving skills.

The findings from semi-structured interviews support that educators understand the significance of using Africanised play-based pedagogy in the online teaching of mental mathematics. Mania and Alam (2021) stated that educators need to integrate the philosophical perspectives of ethnomathematics into their lesson plans. However, educators who participated in this study could not integrate theories of teaching and learning – such as ethnomathematics – that facilitate the application of mathematics and African culture even though it is encouraged by the FP curriculum (CAPS).

6.2.1.3 The roles of educators (MKO) and the application of Zone of Proximal Development (ZPD) in teaching mathematics

The use of principles of MKO and the ZPD was encouraged in Section 2.3, as they play a fundamental role in improving problem-solving skills (McLeod, 2018). Section 2.3.1-2.3.2 discusses how educators (the MKOs) can close the gap to expand learners' mental skills, which are crucial in mental mathematics, using play-based pedagogy. Loizou and Loizou (2022) explained that educators and parents can use the principles of the ZPD by providing children with play-based activities that incorporate culture to encourage social interactions (Li, 2022). Ameri (2020) confirmed that computer technology is also seen as a cultural tool teachers can employ to develop social interaction between educators and learners in teaching and learning activities. In addition, Section 2.3.2 indicated that the role of MKO is to encourage learners to independently apply their mathematical problem-solving skills by playing games during the assessments (Ukobizaba et al., 2021).

A noteworthy finding linked with the theoretical framework of this study was the enhancement of problem-solving skills in the teaching of mental mathematics, which is essential to using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. This notable finding links to the main research question of this study: *How can Africanised play-based pedagogy be used in the online teaching of mental mathematics to FP learners?* These two theories support educators in using Africanised play-based pedagogy in the online teaching of mental mathematics to develop learners' problem-solving skills.

This study's findings from non-participant observations supported the scholarly findings due to several similarities found between the role of cultural activities in teaching mental mathematics, the significance of Africanised play-based pedagogy in

teaching mental mathematics online, and the roles of educators (MKOs), and the application of ZPD in teaching mathematics. Section 5.5.1 presented that educators (MKOs) use Africanised play-based pedagogy in online teaching to develop learners' problem-solving, mathematical and problem-solving skills. Although their educators' lived experiences involved applying ZPD, they knew there were alternative approaches to incorporating play-based pedagogy into online mathematics teaching. They described how they used Kahoot to teach mathematics online. Building upon the theoretical framework's foundation, Section B delves into the empirical data gathered through semi-structured interviews, documents, and non-participant observations analysis to provide valuable insights into Africanised play-based pedagogy in teaching mental mathematics to FP learners online.

6.2.2 Section B: Key Empirical Findings

The summary of the literature review assisted the researcher in connecting the findings to the reviewed literature of the study. This study used a traditional literature review to identify knowledge gaps from the studies on using Africanised play-based pedagogy in teaching mental mathematics to FP learners online. The themes used to discuss the empirical findings were developed from data discussions in Section 5.5.1.

6.2.2.1 Limited understanding of the use of Africanised play-based pedagogy in the online teaching of mental mathematics

The use of Africanised play-based pedagogy in teaching mathematics was discussed in Section 3.2 based on empirical studies conducted in the three years from nine regions such as Asia, Europe, North America (global countries), Ghana, Nigeria, Zimbabwe (Sub-Saharan countries), Free State, KwaZulu Natal and Western Cape (South Africa).

A study conducted in Indonesia, Asia, found a positive correlation between playing a marbles game and enhancing geometric concepts (Kamid et al., 2022). The researcher linked Kamid et al.'s (2022) findings with the application of ZPD by educators (MKO) to develop learners' geometric concepts in mathematics. Fernández-Oliveras et al.'s (2021) study conducted in Switzerland (Europe) found that using traditional games assists interaction and mathematical and scientific thinking. Fernández-Oliveras et al.'s (2021) findings align with integrating culture and social

interaction in teaching mathematics early on. Lastly, Golafshani (2023) indicated that learners in Canada learn abstract mathematical concepts from indigenous storytelling. The Vygotsky's sociocultural theory can be linked to Golafshani's (2023) study as it shows the importance of cultural activities in teaching mathematics.

In Sub-Saharan countries, the study of Tangkur et al. (2022) was conducted in Ghana, and it was found that indigenous games motivate and increase interest in mathematics. The findings of Tangkur et al. (2022) align well with the theoretical framework, showing the importance of Africanised play-based pedagogy in teaching mathematics. Oluwatayo et al. (2020) study from Nigeria found that educators need more time to use game-based learning in teaching mathematics. Oluwatayo et al. (2020) put forward that digital games incorporating traditional culture should be used in teaching mathematics. Sunzuma and Luneta's (2023) findings showed that Zimbabwean educators need more work experience using play-based activities that incorporate culture. Considering this, the theoretical framework of this study emphasises the role of the MKO and ZPD in teaching and learning mathematics.

The study by Moloi et al. (2021), conducted in South Africa, indicated that skipping rope games assist with problem-solving skills and mathematical word problems. Linking the findings of Moloi et al. (2021), it is evident that the role of Africanised play-based pedagogy in teaching mathematics is to promote learners' problem-solving skills. Hadebe-Ndlovu's (2022)study found that indigenous games develop social interaction in mathematics teaching. It was further suggested that digital games with cultural perspectives must be used to teach mathematics. In the same way, Marange and Adendorff (2021) agreed that digital games improve learners' algebraic concepts. They further proposed that educators' role in using digital games is to support learners in developing mathematical concepts. Hadebe-Ndlovu (2022) and Marange and Adendorff's (2021) findings support the theoretical framework of this study in the sense that they encourage social interaction, the responsibility of MKO (support), the use of digital games, and the importance of culture in teaching and learning mathematics.

The findings from the semi-structured interviews seem consistent with other research that found that educators can use African games to teach mathematics. However, it was also indicated that educators need to learn to use Africanised play-based pedagogy in the online teaching of mental mathematics. Section 5.5.1 showed that

educators use online teaching platforms to integrate Africanised play-based pedagogy in teaching mental mathematics to FP learners. In addition, the challenges of the lack of technological devices were discussed concerning the integration of online teaching using in teaching mathematics in the FP. As a result, this study supports Sunzuma and Luneta's (2023) study, which states that educators' exposure to implementing play-based activities that integrate culture is limited. Agreeing with Oluwatayo et al. (2020), the researcher suggests that educators must be trained to use digital games that integrate culture to teach mental mathematics online. Consequently, MKOs will satisfy their roles in incorporating Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. Even though educators indicated limited knowledge of how to use Africanised play-based pedagogy in the online teaching of mental mathematics, they showed their understanding of the role of this pedagogical approach in the FP.

6.2.2.2 The development of problem-solving, mathematical and counting skills

The role of Africanised play-based pedagogy in the online teaching of mental mathematics is to develop learners' problem-solving skills through digital games that incorporate culture (Russo et al., 2021; Dele-Ajayi et al., 2019) in Section 3.3.1. Even though Chirinda (2021), Lunga et al. (2022), and Matsekoleng et al. (2024) did not mention online teaching, they indicated that play-based activities that include African culture also develop learners' problem-solving skills in teaching and learning mathematics.

The study's findings from non-participant observations confirmed that the role of Africanised play-based pedagogy in the online teaching of mental mathematics is to develop problem-solving skills. Even though the participants of this study did not understand that they could use digital games that integrate culture, the findings confirmed the findings from Russo et al. (2021) and Dele-Ajayi et al. (2019) that Africanised play-based pedagogy in the online teaching of mental mathematics assist in the enhancement of problem-solving skills. In addition to prior literature, this study found that Africanised play-based pedagogy in the online teaching of mental mathematics promotes mathematical and counting skills. However, the educators' knowledge of including the role of Africanised play-based pedagogy in their lesson plans needs to be improved.

6.2.3 Minimal Africanised Play-based Activities That Could Be Played Online

Section 3.4 discussed suitable Africanised play-based activities for online teaching of mental mathematics. The literature found that digital games such as Morabaraba, Ludo and Math Zap Cards can be used to teach mathematics online. Mosimege (2020) and Tachie and Galawe (2021) indicate that Morabaraba helps promote learners' counting and problem-solving skills (Shu & Li, 2019). Abdullah (2022) advises MKO to share the screens of their technological devices to encourage learners to play in teams and enhance social interaction in mathematics classrooms. Ulhusna et al. (2020) explained that playing Ludo online increases interest, enthusiasm, and counting skills (Drešar, 2020; Lembrér, 2020). Lastly, Singh et al. (2021) showed that the Math Zap card game develops learners' mathematical skills. In the same view, Rasid et al. (2022) concurred that learners can communicate when playing this game to enhance social interaction skills in mathematics.

In support of existing literature, this study found that educators use Morabaraba, Ludo, Math Zap Cards, Dice and Sudoku games to develop different mathematical skills. For example, S3FPE3 stated:

> *"This question is difficult, eish. However, I believe Morabaraba might be used in online maths teaching. Though I have not played it much, I recently found the game on the Google Play Store. Additionally, there is the online game Sudoku, which incorporates various aspects of African cultures. The Sudoku game could be useful for teaching maths because it incorporates numbers and adding skills. Mathematical skills can be learned in the same way that learners can play online games. I am unsure how to play this game either"* (S3FPE3).

As a result, the findings of this study corroborate what the literature has found. From the views of Abdullah (2022), the researcher argues that MKOs (educators) should encourage learners to play these games in pairs or teams to promote social interaction in mathematics by sharing screens of their technological devices. Even though some educators could identify suitable Africanised play-based activities in the online teaching of mental mathematics to FP learners, most educators showed minimal use of Africanised play-based activities. The evidence is from Section 5.4.3 that only S2FPE3, S1FPE2, S1FPE1, S1FPE3 and S3FPE3 could mention suitable Africanised play-based activities in the online teaching of mental mathematics. They also needed

to improve in including suitable Africanised play-based activities in their lesson planning and implementation in their mathematics classrooms. Lack of knowledge on selecting appropriate Africanised play-based activities limits the role of educators in applying the ZPD to enhance learners' problem-solving, mathematics and counting skills. The following section discusses the inadequate guidelines from the legislative frameworks.

6.2.4 Inadequate Guidelines from the Legislative Frameworks in Teaching

The reviewed literature also focused on legislative frameworks guiding Africanised play-based pedagogy in the FP of teaching. The legislative frameworks worldwide were compared with South Africa's on using Africanised play-based pedagogy in teaching mathematics in Section 3.5. The emphasis on cultural context and play-based pedagogy is from the UNICEF, Zealand, and England (UNICEF, 2022; Westbrook & Hunkin; 2020 & Fisher, 2022). In addition, Fisher (2022) encouraged play-based pedagogy with individuality and cultural activities. Even though Denmark's legislation did not include play-based pedagogy, they emphasised a double philosophical approach, such as a socio-pedagogic tradition and a child-centred approach. Firstly, culture and play-based pedagogy play a significant role in teaching mathematics, one of the similarities between South Africa's legislative framework and those of other countries (DBE, 2018). Lastly, they need more guidance on integrating culture and play-based pedagogy into teaching mathematics. Even though South African FP educators are urged to use the ATP and the NECT (DBE, 2021) for lesson preparation and assessments, the guidelines are still limited.

The findings from the documents, particularly the lesson plans of this study, confirmed that there needs to be more guidelines on using Africanised play-based pedagogy in the FP from the legislative frameworks. Section 5.4.4 explained that educators used CAPS, NECT and ATP guidelines. These guidelines of how educators should implement Africanised and play-based pedagogy need to be revised. S3FPE1 complained that no relationship between lesson and assessment existed between NECT and ATP. Therefore, they used the ATP for formal evaluation. It was observed from the lesson planning and implementation that educators followed the guidelines on using Africanised play-based pedagogy, which is limited.

6.2.5 Lack of Strategies That Support Educators in the Online Teaching of Mental Mathematics

The lack of strategies that support educators in using Africanised play-based pedagogy in online mathematics teaching to FP learners was noticeable from Section 3.6. The researcher reviewed strategies that encourage play-based pedagogy. (Mpofu, Issac, Ndamase, Sonjica and Sapire, 2021) identified that educators can use Bala Wande strategies to teach mathematics in the FP. The literature indicated that enhancing problem-solving skills, including assessment, developmentally appropriate practice and collaboration between stakeholders and parents, could be strategies to integrate play-based learning.

Dai et al. (2023) advocated for the use of digital games equipped with resources, rules and instructions as a means of fostering learners' cognitive abilities and problem-solving skills in mathematics education. In line with this perspective, Mbhiza (2021) underscored the potential of Africanized games, such as Morabaraba and Ludo, which come with clear instructions and regulations, to enhance problem-solving skills. Furthermore, Pyle et al. (2022) suggested that play-based pedagogy should be in harmony with informal, formal or hybrid assessment methods.

Geletu's (2023) study indicated that the South African curriculum needs more individuality and cultural context. He suggested that educators should use systematic scaffolding to accommodate different learners and ensure quality play-based pedagogy teaching. Hayashi et al. (2022) concurred that Africanised play-based activities could be a developmentally appropriate practice. Brottman et al. (2020) explained that online games that integrate culture address inclusivity. The view of Char et al. (2020) is supported by Jost et al. (2019)who stated that even physically challenged learners can play online games to learn mental mathematics. Lunga et al.'s (2022) findings indicate that a strategy that could be used to infuse play-based pedagogy in teaching FP learners is to encourage collaboration between parents and learners. Dong et al. (2020) also affirmed the role of parents and teachers in using Africanised play-based activities. Parents must monitor their children's devices (Bhattacharya et al., 2019).

Very little was found in the current study on strategies that support educators in the online teaching of mental mathematics. It was indicated that most educators use the techniques of the Six Bricks programmes. Section 5.4.5 showed that educators were trained and provided with Lego bricks (mathematical manipulatives) and teachers' guides on using Six Brick's strategies to teach learners in the FP. Although they still need adequate training workshops, Six Bricks does not integrate Africanised play-based pedagogy. Six Bricks includes coding and robotics. However, it was only introduced physically, not online. Kahoot was also seen as a strategy for online teaching in the FP. The research findings from this study's semi-structured interviews, documents and non-participant observations contributed to the conclusions that address the research questions in the next section.

6.3 CONCLUSIONS

This study explored the use of Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. This section made conclusions in addressing the study's primary and sub-research questions. The findings on the sub-questions are the building blocks towards the conclusion to the main question.

6.3.1 The First Research Sub-Question

"What role does Africanised play-based pedagogy play in the online teaching of mental mathematics to FP learners?"

The literature indicated that the role of Africanised play-based pedagogy in the online teaching mental mathematics is to develop learners' problem-solving skills. The study's findings confirmed that the role of Africanised play-based pedagogy in the online teaching of mental mathematics is to develop problem-solving skills. This study found that it also contributes to mathematical and counting skills. The educators' knowledge of including the Africanised play-based pedagogy in their lesson plans needs to be improved.

6.3.2 The Second Research Sub-Question

"What are suitable Africanised play-based activities in the online teaching of mental mathematics to FP learners?"

The literature showed that digital games incorporating cultures, such as Morabaraba, Ludo and Math Zap Cards, can be used to teach mathematics. The findings of this study added that Dice and Sudoku games could also be used to develop learners' mathematical skills in the FP. As the theoretical framework recommends, the educators' (MKO) role is to use different suitable play-based activities that encourage culture to apply the principes of the ZPD in developing learners' problem-solving skills. In addition, the study indicated that minimal Africanised play-based activities could be played online. They also need to improve in including suitable Africanised play-based activities in their lesson planning and implementation in their mathematics classrooms. The lack of Africanised play-based activities limits educators' role in applying the ZPD to enhance learners' problem-solving, mathematics and counting skills.

6.3.3 The Third Research Sub-Question

"What legislative frameworks guide educators using Africanised play-based pedagogy in the foundation phase?"

The literature found that the legislative frameworks that guide educators on using Africanised play-based pedagogy provided clear guidelines on how to integrate Africanised play-based pedagogy. There needs to be more adequate guidelines from the legislative frameworks in teaching. The guidelines from CAPS, NECT and ATP on how educators should implement Africanised play-based pedagogy need to be revised. Lesson planning aligned to the legislative framework needs to be more satisfactory.

6.3.4 The Fourth Research Sub-Question

"What strategies do educators use to support learners using Africanised play-based pedagogy in teaching mental mathematics to FP learners?"

It was shown in the literature that there needs to be strategies that support educators on the use of Africanised play-based pedagogy in teaching FP learners. This study indicated that educators use strategies from Six Bricks because they encourage play-based pedagogy and coding and robotics in the foundation. There is a lack of strategies that support educators in the online teaching of mental mathematics.

6.3.5 The Main Research Question

“How can Africanised Play-based pedagogy be used in the online teaching of mental mathematics to FP learners?”

The evidence from the literature revealed that educators can use digital games that incorporate culture to teach learners mathematics. This study’s findings showed that educators used technological platforms to demonstrate videos of games that incorporated culture to teach FP learners mental mathematics. Although educators stated that they sometimes use Kahoot, they do not include cultural themes in teaching as yet. It was evident that there greater understanding is needed regarding the use of Africanised play-based pedagogy in the online teaching of mental mathematics, despite the apparent constraints posed by the scarcity of technology platforms. Therefore, this study suggests that educators can use Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners by:

1. Applying the theoretical perspectives of ethnomathematics and Vygotsky’s sociocultural theory in lesson planning and implementations
2. As an application of ZPD, the educators can select suitable play (digital games) activities such as Morabaraba, Math Zap Cards, Dices, Ludo and Sudoku. Guided by Abdullah (2022), educators can advise learners to share their technological devices because of the lack of technological devices.
3. The selected digital games should assist learners in developing problem-solving, mathematical and counting skills in teaching mental mathematics.
4. It is the role of educators (MKO) to follow the guidelines from the legislative frameworks and strategies and be creative.

6.4 RECOMMENDATIONS

The recommendations are primarily based on the theoretical framework, the literature reviewed and the findings from the study. The recommendations are presented to the educational hierarchy of South Africa, namely, the provincial departmental level, non-governmental organisations (NGOs), primary schools and parents. This study was conducted in four public primary schools in South Africa, Limpopo Province and

Capricorn South. The district office is the first target of the recommendation because it represents the DBE. The second recommendation is directed towards the NGOs that collaborate with the DBE. The third recommendation is set out to primary schools and educators, while parental involvement in the educational system is the focus of the final set of recommendations.

6.4.1 Recommendations for the Department of Basic Education

One of the main priorities of the CAPS curriculum is to support educators in using play-based pedagogy when teaching mathematics in the FP (DBE, 2011). Furthermore, it encourages them to include African knowledge and the use of technology in various pedagogies, including play-based learning. This study explored the use of Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners to respond to a call for Africanisation, decolonisation and digitalisation in the education context. In collaboration with the DBE (2011), the NECT and ATP design lessons and assessments for all subjects, including mathematics, in the FP.

This study indicated that Africanised play-based activities are only mentioned in a few mental mathematics activities, even though educators are encouraged to use the ethnomathematics theory. The participants noted that there needs to be more alignment of lesson activities from NECT and assessment activities from the ATP. In addition, play-based activities are mostly mentioned but only in some mental activities. In addition, there are no guidelines on how educators can use online teaching of mental mathematics to FP learners. Lack of knowledge on using Africanised play-based activities could result from insufficient guidelines on how educators can plan and implement Africanised play-based pedagogy in the online teaching of mental mathematics. This present study proposes several recommendations to promote Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. Specifically, the recommendations encourage close collaboration between DBE, NECT and ATP concerning lesson planning, implementation and assessments:

- **Recommendation 1**: Section 1.1 indicates that CAPS encourages educators to integrate the components of ethnomathematics theory in teaching mathematics to FP learners. In addition, in Chapter 2, educators are advised to use ethnomathematics and Vygotsky's sociocultural theories to understand the role of

cultural activities in teaching mathematics and employing play-based pedagogy. This study demonstrated that educators need to gain knowledge on formulating and implementing lessons and assessment activities underpinned by teaching and learning theories. There should be guidelines on how educators plan their activities guided by the philosophical orientations of relevant theories or philosophies in teaching mathematics in the FP.

- **Recommendation 2:** The study indicated no relationship between the lesson activities from NECT and assessment activities from ATPs. Therefore, this study suggests that CAPS should foster the lesson-assessment relationship in line with their curriculum outcomes.

- **Recommendation 3**: The curriculum encourages educators to use cultural play-based activities in online mathematics teaching to FP learners. The reviewed literature indicated that educators could use digital games such as Morabaraba, Ludo and Math Zap Cards to teach mental mathematics in the FP. The findings of this study supported the idea that Dice and Sudoku can also be used to apply the principles of the ZPD to enhance learners' mathematical skills in the FP. Therefore, this study suggests that educators should have formal training on using these digital play-based activities to promote problem-solving, mathematical and counting skills.

- **Recommendation 4**: The CAPS policy encourages educators to use technology in teaching and learning. The literature attested that through online teaching platforms, learners develop digital skills that contribute to problem-solving skills. This study's findings showed a challenging shortage of technological devices for online teaching. It was demonstrated that School 2 used the government's funding to purchase smartboards, internet hubs and generators. Therefore, this study recommends that the DBE could motivate other schools to fund online teaching in their schools.

- **Recommendation 5**: The current study found that the educator's lesson planning on using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners needs to be more satisfactory. Only S3FPE3 planned the lesson on the DBE's website, Thutong time, using digital resources such as

videos for online teaching. It was confirmed that only some educators attended training on planning lessons on Thutong time. As such, the study suggests that all FP educators need professional workshops on planning their lessons guided by CAPS, NECT and ATPs on using Africanised play-based pedagogy in online mathematics teaching.

6.4.2 Recommendations for the NGOs

The theoretical framework and reviewed literature showed that educators should use strategies in Africanised play-based pedagogy in the online teaching of mental mathematics. The findings indicated that the educators follow the strategies of Six Bricks. Even though they encourage coding and robotics, they are still used manually in the FP, using Lego bricks to teach all subjects, including mathematics.

- **Recommendation 6:** The researcher recommends that educators receive enough training and ongoing monitoring and evaluation activities. They can also introduce robotics and coding through technological tools to develop learners' digital skills.

6.4.3 Recommendations for Educators

This study's theoretical framework showed that educators play a significant role in using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. Loizou and Loizou (2022) affirm the roles of educators (MKO) and the application of the ZPD in teaching mathematics. In addition, Ukobizaba et al. (2021) agreed that educators can motivate learners by playing digital games that incorporate culture for assessment activities. The findings of this study showed that educators refer to CAPS, NECT and ATP to design lesson plans for mathematics in the FP. They mentioned that some mental mathematics from these legislative frameworks does need to incorporate Africanised play-based pedagogy or play-based learning activities.

- **Recommendation 7:** The researcher recommends that for the professional development of educators, they can enrol in a SACE-accredited free online course about play-based learning in the FP, Powerful Learning Around You (PLAY), using this link: www.playsa.org. This programme partners with DBE, UNICEF, the Lego Foundation and Cotlands.

- **Recommendation 8:** The findings indicated that more guidelines on using online teaching in the FP need to be implemented. The educators can enrol in free e-learning courses offered by the University of Witwatersrand and Cape Town. For example, they can sign up for Education for All, emphasising disability, diversity and inclusion in the classroom. This recommendation is supported by Brottman et al. (2020) and Jost et al. (2019), who stated that online games that integrate culture address inclusivity, and physically challenged learners engage in play-based pedagogies to learn mental mathematics.

- **Recommendation 9:** Educators mentioned that Kahoot is another way to incorporate Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. They only use it through competitions by infusing different assessment activities that learners must complete online. The researcher suggests that educators can choose topics that integrate African culture. Artificial intelligence programmes can be used to automatically generate the most relevant questions related to the selected topic.

- **Recommendation 10:** As learners only have a limited number of tablets, educators can encourage them to collaborate by having them share screens on their gadgets (Abdullah, 2022). Learners can also play digital games in groups and share tablets to develop problem-solving, mathematical and counting skills.

- **Recommendation 11:** Guided by Dochshanov and Tramonti (2022) that digital games can be downloaded on Android and Apple devices, the researcher recommends that educators download digital games that integrate African culture on their technological devices. This suggestion could assist educators in incorporating digital games even during load shedding and when they experience connectivity issues.

6.4.3 Recommendations for Parents

The theoretical framework and literature review indicated that parents have a crucial role in using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. Loizou & Loizou (2022) and Li (2022) confirmed that educators and parents (MKO) can use the ZPD by providing children with play-based activities that incorporate culture to encourage social interactions. Furthermore, Lunga

et al. (2022) explained that collaboration between educators and parents can support educators in using Africanised play-based pedagogy in the online teaching of mental mathematics.

Recommendation 12: Educators must collaborate with parents by sharing ideas on using digital games that integrate culture to ensure the effectiveness of implementing Africanised play-based pedagogy in teaching mental mathematics to FP learners online. The role of parents is to support their children by assisting them with their home assessment activities and asking them questions to foster problem-solving skills. They can guide their children to balance screen time, reading and outdoor play-based activities.

Recommendation 13: Parents may also monitor their children's tech usage to ensure they learn mathematics through age-appropriate games and avoid cyberbullying. The educators can suggest reliable apps for learning mathematics that have undergone safety and quality assurance checks. They can also offer details on how these applications complement learning objectives and fit within legislative frameworks.

6.5 A SUGGESTED FRAMEWORK TO EDUCATORS IN USING AFRICANISED PLAY-BASED PEDAGOGY IN THE ONLINE TEACHING OF MENTAL MATHEMATICS

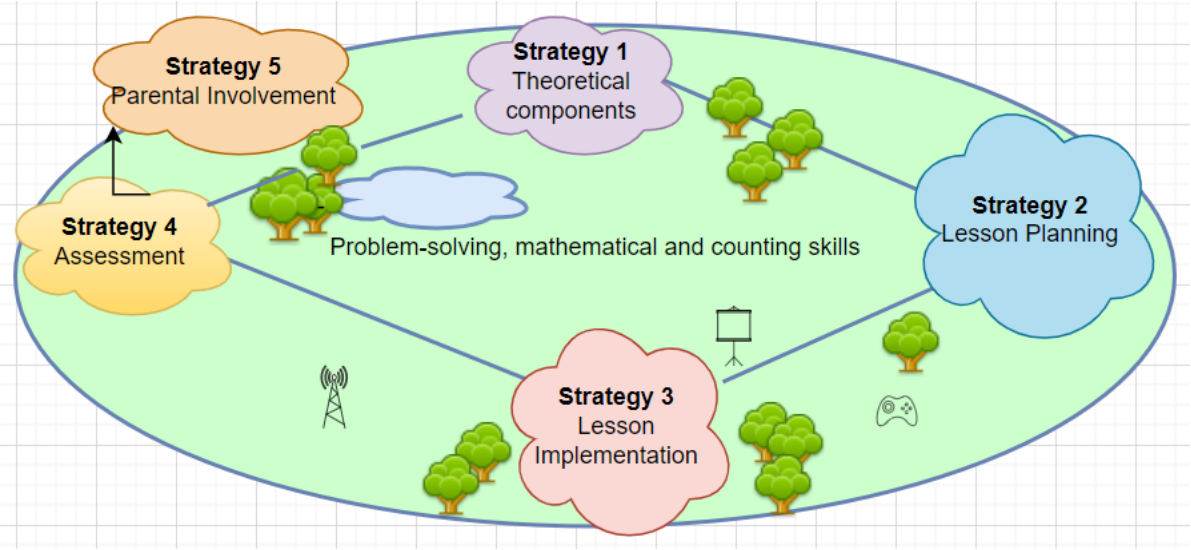
The fourth sub-research question asked: *What strategies do educators use to support learners using Africanised play-based pedagogy in teaching mental mathematics to FP learners?* The study's findings indicated that more strategies are needed to support educators using Africanised play-based pedagogy in the online teaching of mental mathematics. Section 1.1 specified that this study contributed to the South African policy development in teaching mathematics in the FP but was not limited to global legislative frameworks. The DBE (2011) stresses including indigenous knowledge, culture, ethnomathematics and technology in teaching mathematics in the FP. Section 3.5 reviewed legislative frameworks from UNICEF, Zealand, England and Denmark because they encourage educators to integrate culture and play-based pedagogy in teaching mathematics in ECE. Nevertheless, there is a need for more strategies that support educators in using Africanised play-based pedagogy in teaching mathematics from these regions.

The theoretical framework, literature review and findings support this study's suggested strategies. As required by applied research used in this study, the suggested strategies contribute to the solution to the problem in this study. They point out the importance of integrating cultural activities and their roles in teaching mathematics (Section 2.2.2) as components of ethnomathematics theory and the role of the MKO and the ZPD in using play-based pedagogies that incorporate culture to develop social interaction as per Vygotsky's sociocultural theory (Section 2.3.1-2.3.2). The literature review revealed that since strategies to support educators in using Africanised play-based pedagogy in teaching mathematics are not clearly defined, educators can be guided by enhancing problem-solving skills, including assessment, developmentally appropriate practice and collaboration between stakeholders and parents in using play-based pedagogy (Section 3.6.1-3.6.3). This study's findings indicated that participants could choose suitable digital games to develop learners' mathematical skills in teaching mathematics. Furthermore, they could use technological platforms to engage in the online teaching of mental mathematics to FP learners. However, they were not able to choose relevant teaching and learning theories and integrate Africanised play-based pedagogy in lesson planning, implementation, and assessment (Section 5.5).

The suggested strategies include "*ethnomathematics and Vygotsky's model of Africanised play-based pedagogy in the online teaching of mental mathematics*." Five strategies are broken down into sub-strategies. Strategy 1: Theoretical orientations; Strategy 2: Lesson Planning; Strategy 3: Lesson Implementation; Strategy 4: Assessment and Strategy; and 5: Parental Involvement. The interpretivist paradigm, explained in Section 4.2, guided this study and is consistent with ethnomathematics and Vygotsky's sociocultural theory which supports Africanised play-based pedagogy in the online teaching of mental mathematics.

This study proposes a framework for using ethnomathematics and Vygotsky's sociocultural model in designing Africanised play-based pedagogy in the online teaching of mental mathematics. This study includes the literature review, findings, and recommendations (Section 6.4). Figure 6.1 presents the model framework that aligns with Figure 2.2, showing that it relates to the theoretical framework that underpins this study. Ethnomathematics and Vygotsky's sociocultural theory indicated that learners develop problem-solving skills when engaging in play-based activities

incorporating cultural and social interaction to learn mathematics. The theoretical framework informed the hermeneutic phenomenological research design and the use of this model to implement strategies on using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners.



(The design of this framework was assisted by draw.io)

Figure 6.1: The suggested framework on Africanised Play-based Pedagogy for Online Teaching

Figure 6.1 displays a suggested model incorporating five strategies that support educators in using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. The first strategy includes the theoretical components from the two theories, such as ethnomathematics and Vygotsky's sociocultural theory, to guide educators on using Africanised play-based pedagogy in teaching mathematics. The second strategy relates to this study's findings due to educators' limited lived experiences in integrating Africanised play-based pedagogy in the planning of the lessons. Third, there is a focus on executing the designed lesson activities online in alignment with the planned curriculum. Fourth, it is recommended to employ appropriate play-based activities within the ZPD. Last, collaboration with parents is advocated to bolster their children's mathematical proficiency. These strategies are interconnected and underscore the enhancement of problem-solving, mathematical and counting skills in teaching mathematics during the FP.

6.5.1 Strategy 1: Theoretical Components

Teaching and learning theories incorporate the components of child development that assist educators in understanding the holistic development of FP learners. The theories guide evidence-based pedagogies to cater to diverse learning styles and interactive mathematics lessons. Therefore, the educators need to understand how to underpin their lessons using the theoretical orientations. For using Africanised play-based pedagogy in the online teaching of mental mathematics in the online teaching of mental mathematics to FP learners, the researcher suggests that educators can use the theoretical components of ethnomathematics and Vygotsky's sociocultural theories to understand the importance and role of integrating culture and social interaction in their mathematics lessons.

6.5.2 Strategy 2: Lesson Planning

This study recommended that educators need training in designing lesson plans on Thutotime. The legislative frameworks guide lesson design, ensuring the lesson's objectives align with the frameworks. The educators must align the lesson's objectives with the theoretical framework chosen in Strategy 1 and mental mathematics activities to FP learners. The educator must plan to use different African play-based activities to develop learners' problem-solving, mathematical and counting skills as they are important in mental mathematics to FP learners. Therefore, the consolidation (the body of the lesson plan) of mathematical concepts must align with the mental mathematics activities to enhance higher problem-solving, mathematical and counting skills. The lesson's conclusion must drive learners to the assessment that links with the mental mathematics activities.

6.5.3 Strategy 3: Lesson Implementation

The educators need to follow the lesson plan designed in Strategy 2. This study found that there is a need for more technological devices. The study suggests that educators can advise learners to work in groups by sharing technological devices and playing suitable Africanised play-based activities to increase social interaction in the classroom. The educators can display Africanised play-based activities such as Math Zap Cards, Dice, Ludo, Morabaraba and Sudoku during mental mathematics. The

educators must ask learners probing questions while playing to challenge them to enhance their problem-solving, mathematical and counting skills.

6.5.4 Strategy 4: Assessments

The assessments should be aligned with the ideas of Africanised play-based pedagogy, emphasising tasks and experiences relevant to real-life situations. Educators must use assessments to include classroom diversity and identity and accommodate learners with mathematics barriers to develop problem-solving, mathematical and counting skills more comprehensively. Differentiated assessments can address diverse learning styles, needs and mathematical skills. These assessment activities must be clearly stated in Strategy 2. Since assessments of learning (continuous assessments) are used in the FP, the informal assessments that educators use in learners' activity books should inform formal assessments or School-Based Assessments. The educators can refer to ATP for formal assessments. Lastly, educators must include constructive feedback to learners by using appropriate language while acknowledging learners' diverse backgrounds.

6.5.5 Strategy 5: Parental Involvement

The parents as MKOs should support the learning continuity of mathematics by actively participating in their children's online learning experiences. They can reinforce mathematical concepts taught through Africanised play-based pedagogy by including routine activities at home. Educators collaborate more effectively to build integrated learning experiences outside the classroom to develop mental mathematics skills in FP learners. Playing the Morabaraba game at home aligns with developing problem-solving skills and mathematical concepts. Parents can provide educators with insightful input about their children's learning experiences and needs that can be met using individualised assessment activities (Strategy 4). Lastly, children can develop digital literacy skills by navigating online teaching platforms, accessing digital resources and technological troubleshooting; for example, by exploring educational websites like Khan Academy and Mathletics that provide immediate feedback to FP learners. In addition, parents can support their children to address the technical issues.

The researcher suggests that educators can revisit their lived experiences during stimulated recall activities by evaluating themselves. The self-evaluation aligns with

the recommended strategies for using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. Figure 6.2 displays a suggested educator self-evaluation template.

EDUCATOR SELF-EVALUATION TEMPLATE

Name of the educator:
Name of the school:

Subject: Mathematics

Grade 1 ☐	Grade 2 ☐	Grade 3 ☐

Date:

Strategies	Self-Evaluation Areas	Very Confident 4	Fairly Confident 3	Not Very Confident 2	Not Confident 1	Notes
Strategy 1 Theoretical components	I have sufficient skills to use the theoretical components.	☐	☐	☐	☐	
	I understand the significance of integrating African culture into teaching mathematics.	☐	☐	☐	☐	
	I understand the role of MKO and the application of ZPD in teaching and learning mathematics.	☐	☐	☐	☐	
Strategy 2 Lesson Planning	I can use Africanised play-based pedagogy in the online teaching of mental mathematics.	☐	☐	☐	☐	
	I can plan my lesson guided by the legislative framework.	☐	☐	☐	☐	
	My lesson plan provides clear objectives (to develop learners' problem-solving,	☐	☐	☐	☐	

	mathematical and counting skills).					
Strategy 3 Lesson Implementation	I can include suitable Africanised play-based activities in teaching mathematics that include the application of ZPD.	☐	☐	☐	☐	
	I can implement lessons that incorporate online teaching.	☐	☐	☐	☐	
Strategy 4 Assessments	I can use assessment activities that align with the mental mathematics activities.	☐	☐	☐	☐	
	I can use assessment activities that appreciate classroom diversity, culture and individual differences.	☐	☐	☐	☐	
Strategy 5 Parental Involvement	I can include parental involvement in the teaching and learning activities.	☐	☐	☐	☐	
	I can share ideas and lived experiences with parents to stimulate the learning of mathematical concepts through home routines.	☐	☐	☐	☐	

Figure 6.2: Suggested educator self-evaluation template

The educator's biographical information, including the lesson's implementation date, is included in the upper section of the suggested educator self-evaluation template. The first column shows the strategies that align with self-evaluation areas in the second column. The educators assess themselves using the indicator criteria in columns three through six. The last column allows educators to comment on each region. In the following section, the researcher recommends future research based on the suggested framework, self-evaluation assessments and the study's findings.

6.6 RECOMMENDATIONS FOR FUTURE RESEARCH

The findings of this study and the suggested framework for the use of Africanised play-based pedagogy in the online teaching of mental mathematics have several significant implications for future research:

- There is room for further progress in exploring the FP of educators' professional development using the suggested framework and self-evaluation assessment. A mixed methodology, longitudinal study is recommended to be carried out for at least three years, and enough data will have been gathered to allow the conclusions to be applied to a larger population.
- Further research should be done to investigate the mathematics achievement of learners in the FP after the educators have acquired adequate skills in using the suggested framework.
- It would be interesting to explore the use of coding and robotics, artificial intelligence and Kahoot in teaching mathematics in the FP.

6.7 CONCLUDING REMARKS

This chapter summarised the study's research findings. The aim of this study was achieved, and the objectives set in Section 3.2 were met. Finally, the research questions were addressed in anticipation of adopting the suggested strategies and educator self-evaluation template. The suggestion of strategies and educator self-evaluation templates prompted further research into using Africanised play-based pedagogy online in teaching mental mathematics to FP learners.

This study contributed to the body of knowledge in teaching and learning mathematics in the FP. It closed a knowledge gap in using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners. The effectiveness of using Africanised play-based pedagogy relies on its role, the guidance from the legislative framework, the use of suitable African play-based activities, and the suggested strategies that support educators to successfully implement this pedagogical approach in the online mathematics teaching to the FP learners.

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APPENDICES

APPENDIX A: UNISA RESEARCH ETHICS APPROVAL

UNISA university of south africa

UNISA COLLEGE OF EDUCATION ETHICS REVIEW COMMITTEE

Date: 2023/10/11

Ref: **2023/10/11/64019209/38/AM**
Name: Ms MA Selepe
Student No.:64019209

Dear Ms MA Selepe

Decision: Ethics Approval from 2023/10/11 to 2028/10/11

Researcher(s): Name: Ms MA Selepe
E-mail address: 64019209@mylife.unisa.ac.za
Telephone: 082 6495 911

Supervisor(s): Name: Dr RSS Mphahlele
E-mail address: Emphahrs@unisa.ac.za
Telephone: 012 429 4941

Title of research:

USING AFRICANISED PLAY-BASED PEDAGOGY IN THE ONLINE TEACHING OF MENTAL MATHEMATICS TO FOUNDATION PHASE LEARNERS

Qualification: PhD Education

Thank you for the application for research ethics clearance by the UNISA College of Education Ethics Review Committee for the above mentioned research. Ethics approval is granted for the period 2023/10/11 to 2028/10/11.

*The **medium risk** application was reviewed by the Ethics Review Committee on 2023/10/11 in compliance with the UNISA Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.*

The proposed research may now commence with the provisions that:

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

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

3. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the UNISA College of Education Ethics Review Committee.
4. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
5. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing.
6. The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study. Adherence to the following South African legislation is important, if applicable: Protection of Personal Information Act, no 4 of 2013; Children's act no 38 of 2005 and the National Health Act, no 61 of 2003.
7. Only de-identified research data may be used for secondary research purposes in future on condition that the research objectives are similar to those of the original research. Secondary use of identifiable human research data requires additional ethics clearance.
8. No field work activities may continue after the expiry date **2028/10/11**. Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.

Note:

The reference number **2023/10/11/64019209/38/AM** *should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.*

Kind regards,

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

Prof Mpine Makoe
EXECUTIVE DEAN
qakisme@unisa.ac.za

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

APPENDIX B: APPROVAL FROM THE LIMPOPO DEPARTMENT OF EDUCATION

LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
EDUCATION

CONFIDENTIAL

Ref: 2/2/2 Enq: Makola MC Tel No: 015 290 9448 E-mail:MakolaMC@edu.limpopo.gov.za

ontein
9301

RE: REQUEST FOR PERMISSION TO CONDUCT RESEARCH

1. The above bears reference.
2. The Department wishes to inform you that your request to conduct research has been approved. Topic of the research proposal: **"USING AFRICANISED PLAY-BASED PEDAGOGY IN THE ONLINE TEACHING OF MENTAL MATHEMATICS TO FOUNDATION PHASE LEARNERS."**

3. The following conditions should be considered:

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

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

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

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

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

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

Cnr 113 Biccard & 24 Excelsior Street, POLOKWANE, 0700, Private Bag X 9489, Polokwane, 0700
Tel:015 290 7600/ 7702 Fax 086 218 0560

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

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

Best wishes.

30/10/2023

Mashaba KM
DDG: CORPORATE SERVICES

Date

Cnr 113 Biccard & 24 Excelsior Street, POLOKWANE, 0700, Private Bag X 9489, Polokwane, 0700
Tel:015 290 7600/ 7702 Fax 086 218 0560

APPENDIX C: COMMITTEE CLEAR CERTIFICATE FROM LIMPOPO PROVINCIAL RESEARCH ETHICS

CONFIDENTIAL

LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

OFFICE OF THE PREMIER

Office of the Premier

Research and Development Directorate

Private Bag X9483, Polokwane, 0700, South Africa

Tel: (015) 230 9910, Email: mokobij@premier.limpopo.gov.za

LIMPOPO PROVINCIAL RESEARCH ETHICS

COMMITTEE CLEARANCE CERTIFICATE

Review Date: 27 November 2023

Project Number: LPREC/144/2023: PG

Subject: Using Africanised Play-Based Pedagogy in the Online Teaching of Mental Mathematics to Foundation Phase Learners

Researcher: Selepe MA

Chairperson: Prof I Swarts

Swarts

Chairperson: Limpopo Provincial Research Ethics Committee

The Limpopo Provincial Research Ethics Committee (LPREC) is registered with National Health Research Council (NHREC) Registration Number **REC-111513-038.**

Note:

i. **This study is categorized as a Low Risk Level in accordance with risk level descriptors as enshrined in LPREC Standard Operating Procedures (SOPs)**

ii. **Should there be any amendment to the approved research proposal; the researcher(s) must re-submit the proposal to the ethics committee for review prior data collection.**

iii. **The researcher(s) must provide annual reporting to the committee as well as the relevant department and also provide the department with the final report/thesis.**

iv. **The ethical clearance certificate is valid for 12 months. Should the need to extend the period for data collection arise then the researcher should renew the certificate through LPREC secretariat. PLEASE QUOTE THE PROJECT NUMBER IN ALL ENQUIRIES.**

APPENDIX D: APPROVAL FROM THE PRINCIPAL FROM SCHOOL 2

DEPARTMENT OF EDUCATION
LIMPOPO PROVINCE

PRIMARY SCHOOL
EMIS NUMBER 92 41429

LIMPOPO
PROVINCIAL GOVERNMENT
EDUCATION

Private Bag X7 99
Polokwane
0700

Enquiry:
Cell NO: 0

Dear sir/madam

RE: Letter of acknowledgement

1. The above matter bares reference
2. This is to acknowledge that Mmakgabo Angelinah Selepe did conduct research in our school with foundation phase grade (grade1-3) educators who are teaching mathematics.

Kind regards.

PRIMARY SCHOOL
DEPT. OF EDUCATION
LIMPOPO PROVINCE
05 -12- 2023
SMT:
PRIVATE BAG X7 9, POLOKWANE, 0700

APPENDIX E: CONSENT LETTER FROM THE PARTICIPANT

Consent letter to participants

CONSENT TO PARTICIPATE IN THIS STUDY

I, [redacted] ude your name and surname), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

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

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

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

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

I agree to the recording of the interviews, sharing copies of lesson plan and learners' class activity books and being observed when teaching mathematics.

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

Participant Signature — Date: 15/01/2024

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

M.A Selepe.

Researcher's signature — Date: 11/09/2023

64019209@mylife.unisa.ac.za

(signature)

Mphahlele Ramashego

Emphahrs@unisa.ac.za

Supervisor

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

APPENDIX F: CONSENT LETTER FROM THE PARENT

Consent letter to parents

Enquires: Selepe M.A
Contact: 0826495911
Date: 11 September 2023

Dear Parent

Requesting parental consent to allow your child/ren to participate in a research project

Title of the research: Using Africanised play-based pedagogy in the online teaching of mental mathematics to foundation phase learners.

Aim: to explore the use of Africanised play-based pedagogy in the online teaching of mental mathematics to foundation phase learners.

My name is Mmakgabo Angelinah Selepe am doing research under supervision of Dr RSS Mphahlele, a senior lecturer in the Department of Early Childhood Education, I am studying towards PhD in Early Childhood Development at the University of South Africa.

I am requesting your permission to include your child when observing his/her educator is teaching mathematics.
I expect to have your child and other children participating in the study. If you allow your child to participate. Your children's face will not be used anywhere in the study. With your permission, your child will be requested to sign the assent form which accompanies this letter.If your child does not wish to participate in the study, he or she will not be included and there will be no penalty Any information that is obtained in connection with this study and can be identified with your child will remain confidential and will only be disclosed with your permission. His/her work will not be linked to his/her name or your name or the school's name in any written or verbal report based on this study. Such a report will be used for research purposes only.

Your child will receive no direct benefit from participating in the study; however, his/her educator will benefit because researching and implementing this pedagogical approach can also contribute to the professional development of teachers, helping them adapt to new teaching methods and technologies. Foundation Phase learner can learn mental mathematics more effectively and

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

enjoyably using play-based pedagogy, resulting in better comprehension and memory of mathematical ideas.

Neither your child nor you will receive any type of payment for participating in this study. Your child's participation in this study is voluntary. Your child may decline to participate or to withdraw from participation at any time. Withdrawal or refusal to participate will not affect him/her in any way. Similarly you can agree to allow your child to be in the study now and change your mind later without any penalty. The study will take place during mathematics period within regular classroom activities with the prior approval of the school and your child's educator. However, if you do not want your child to participate, there is no other alternative activity will be available.

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

If you have questions about this study please ask me or my study supervisor, Dr RSS Mphahlele, Department of Early Childhood Education, College of Education, University of South Africa. My contact number is 0826495911 and my e-mail is 64019209@mylife.unisa.ac.za. The e-mail of my supervisor is Emphars@unisa.ac.za . Permission for the study has already been given to the principal and the Ethics Committee of the College of Education, UNISA.

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

Sincerely

R.P. — 16 January 2024

Parent Signature — Date

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

M.A Selepe — 11/09/2023

Researcher's signature — Date

(signature)

Mphahlele Ramashego

Emphahrs@unisa.ac.za

Supervisor

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

APPENDIX G: ASSENT LETTER FROM THE CHILD

Assent letter to child

Enquires: Selepe M.A
Contact: 0826495911
Date: 11 September 2023

Dear learner

Requesting assent consent to participate in a research project

My name is Mmakgabo Angelinah Selepe and would like to ask you if I can observe the educator while teaching you mathematics. I am trying to learn more about how children learn mental mathematics through the use of Africanised play-based pedagogy in the online teaching of mental mathematics to foundation phase learners. I will observe you playing with other learners to learn mental mathematics.

I will also ask your parents if you can take part. If you do not want to take part, it will also be fine with me. Remember, you can say yes or you can say no and no one will be upset if you don't want to take part or even if you change your mind later and want to stop. You can ask any questions that you have now. If you have a question later that you didn't think of now, ask your parent or/and educators and they would communicate with me through phone calls or emails. Please speak to guardian or parents about taking part before you sign this letter. Signing under yes or know. If you don't know please ask your parents. A copy of this letter will be given to your parents.

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

Your Name	Yes I will take part	No I don't want to take part	I don't know
			
Signature of the learner			
Date	24/01/2024		
Witness			

Researcher's signature
64019209@mylife.unisa.ac.za

11/09/2023
Date

(signature)
Mphahlele Ramashego
Emphahrs@unisa.ac.za
Supervisor

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

APPENDIX H: A SAMPLE OF INTERVIEW TRANSCRIPT FROM S4FPE3

Section 1: History and Context

1. How did you become a mathematics educator in the FP?

I studied Bachelor of Education in senior and FET. I majored in business management and economics studies. I was placed in Grade 1 by Funza Lushaka bursary. The district office advised me to request at school to teach Grade 3 because I don't have a FP qualification. That is how I ended up teaching Grade 3 mathematics.

2. How can you describe your past experiences that brought you to this position?

I have been teaching Grade 3 mathematics and other subjects since 2016. I have eight years of teaching experience.

3. Do you identify your ethnicity to be African?

Yes

4. Do you have experience in using play-based pedagogy in teaching mathematics in the FP?

Yes. Sometimes we use songs for entertainment and for learners to be interested in what they are going to learn during concept development. We have Six Bricks to help learners to develop mathematical skills. They play games and you can also learn different mathematical abilities of maybe shapes, patterns and additions.

5. Do you know how to integrate online teaching in the FP?

Yes, I am. But at the end of the day, we don't have technological gadgets at our school.

Section 2: Reconstruction of educators' experiences

6. How do you think Africanised play-based pedagogy could be used in online teaching?

A teacher needs to be adaptable, in my opinion. Anything that can pique learners' interest in what you are going to teach them can be used. One of the things that happens when there are two learners and you are not being as humorous and engaging as you can be, is that learners eventually become disinterested. Based on the tasks you've completed, all you need to do is be creative in ways that will encourage people to learn more and desire to spend time with you.

6. How would you integrate technology into your teaching and learning activities?

As educators, technology tends to simplify things for us. Because students can access information if we have a large number of computers and they have tables. Additionally, especially online, I have access to information that I can share with them. because the ideas behind the things we do originate from a plethora of sources. You can also share a lot of videos with the students. If we had those gadgets, I believe it would be quite simple. Thus, in my opinion, it is both crucial and beneficial while instructing students, particularly given how fascinated they are with technology. They adore smartphones, so if we could incorporate online teaching.

7. How can FP learners be taught mental mathematics online using an Africanised play-based pedagogy? Please elaborate

Okay. Let me start by mentioning some songs that we occasionally play for the kids. For instance, we occasionally play “My Younger, Younger, Younger” to help them learn how to subtract. We play this game outside on occasion. They count the number of units left in the line, which aids in their understanding that the concept of subtraction indicates a decrease in quantity and to be able to count both forward and backward when we need to complete those tasks.

8. What are some ways to teach FP learners mental mathematics online using an Africanised play-based pedagogy?

By using Kahoot, I may say. Honestly speaking, though, we don’t utilize it that often. The circuit manager never allows learners to use it; instead, we only utilize it in response to messages that say something like, “This time, I will be coming to the school and I need to see this. You understand that?” The opportunity to say “Get ready for Kahoot” is then presented to us. Because they don’t do it frequently, learning becomes challenging. We exclusively participate in it during interschool contests. If there aren’t any competitions, we essentially don’t use it for teaching and learning activities. The gadgets are limited and we only get them during the competitions. I was only told in 2022 when I was told there are tablets for learners. Our school has challenges since a small number of teachers have an internet connection. They did not provide us with the password for the WiFi that we have. During teaching and learning activities, we occasionally use our data.

7. How do you do competition through Kahoot?

As I mentioned earlier, we would have received notification that this day is a competition. After we have trained our learners, we take them to the competitions, where you will notice that we hand them tablets and place them in groups. After that, we go online and answer any questions we receive—the majority of them choose educators for circuits. For instance, by the time we write this, school A may have already set a mathematics examination and made it available online for students to access. We are supervised by people. The grades are automatically assigned. After they receive the results, they declare which school was the best. At a specific school, we get together.

9. What is the significance of using Africanised play-based pedagogy in in the online teaching of mental mathematics to FP learners?

To spark learners' enthusiasm in math. I've found that when you inform students that we are heading to the computer lab today, they become enthusiastic. Because the gadgets are insufficient, we group learners.

10. What function does Africanised play-based pedagogy serve in teaching FP learners mental mathematics online? Please explain how.

They are developing their sensory motor skills as they answer the questions and use their little fingers to touch the keyboards. They even take pride in answering questions correctly. Kahoot, for instance, provides immediate feedback.

11. In your past experiences, what were the roles of integrating African games in teaching mathematics?

The question you are asking is fascinating and crucial. I think it was yesterday I was I was speaking about indigenous games we used to play in preschool. So there was there was this teacher. I don't remember her name, but then she was teaching us a song in mathematics, it was about patterns. But by that time, they were not telling us this is the pattern, you know, but then she was teaching us a song that says "Pata ya bo kubu le bo kwena". So I still remember it now. It was quite curious to observe how they were instructing us. In the future, they will remember enjoyable things. Maths would then be enjoyable and intriguing to learners. Long-term memory is formed by it.

12. Which African play-based activities could be used in the online teaching of mental mathematics to FP learners?

It would be difficult, particularly when incorporating indigenous games into online teaching. Because indigenous play-based activities are typically physical. You need to have a certain competence in technology to enable learners to actively engage in play-based activities while simultaneously learning mathematical concepts. Not every teacher can do that.

13. Do you think African games could be used in the online teaching of mental mathematics? if yes, for what reason?

I think so. There's a game where students pack things based on their shapes like Logos. Some games teach players colours while being entertaining as well. similar to Candy Saga. Young learners find them engaging. Additionally, we have activities that encourage students by prompting them with a motivational statement or phrases. I'm not much into video games. However, I think there are a ton of online games that might be utilized to teach arithmetic to students. I don't utilize games for teaching and learning because I'm not a big admirer of them.

14. Do you have any legislative framework that guides you on incorporating Africanised play-based pedagogy in the FP?

Not in a true sense. There are no guidelines for online lessons in our policies. It's all the teachers' inventiveness. As an educator, you have the freedom to be imaginative and come up with something that students can do online that is both highly engaging and culturally relevant. Our existing policies do not support Africanised play-based pedagogy in the online teaching of mathematics in the FP.

8. Are there any policies that support play-based learning in teaching mathematics in the FP?

Yes. That being said, the CAPS policy does not specifically state which play-based activities should be used for which lessons. I would demonstrate to you what I mean if I had it with me. For instance, in our session today, we talked about mentally calculating numbers by counting both forward and backward. Is that considered play? Although they occasionally state that learners should play cards, they never clarify how. It depends on the teacher's creativity. Teaching these young children requires constant pleasure and curiosity.

15. Do you have any strategies that you follow when using Africanised play-based pedagogy in the online teaching of mental mathematics in the FP? If Yes, what are those strategies?

I've participated in a Six Bricks course. I found it to be rather intriguing. Because it aids in classroom management, child discipline, helping students concentrate and even recall material, and maintaining their attention on what you have to say. When you utilize Lego bricks to engage students, you can say, "Red, red," and they will respond, "On my toes." Due to their strong sense of competition, kids would naturally want to get involved.

9. Did you know that Six Bricks integrates coding and robotics?

They handed us booklets about coding and robotics, but I recall that day we didn't do that. The majority of us are still uninformed on how to integrate coding and robotics in the FP. That was not included in the training.

10. Did they select the educators or did all FP educators attend?

All of them attended.

11. Do you have strategies on how to implement online teaching in the FP?

We have never participated in any online teaching training. While I am aware that Gauteng is more advanced than Limpopo in terms of online education, Limpopo is still behind. They are also equipped with technology. Maybe that is why we don't have such strategies in Limpopo. If learners in Gauteng and Limpopo were given tablets, pupils in Gauteng would perform amazing feats. Not every learner in our programme has access to a smartphone at school and home.

16. Do you think of any additional experiences in your profession that can contribute to your knowledge, opinions, or belief regarding how to use Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners?

    I have acquired technological knowledge to better equip myself. It is still a case that educators are illiterate with Microsoft skills while others are unable to obtain material from the internet. However, it is related to a teacher's creativity and activity. Teachers must outfit themselves with technology and subject-matter expertise. The majority of educators possess indigenous knowledge that can be applied to teaching and learning, but they lack technological expertise.

Section 3: <u>This part is for Grade 3 educators only</u>

Session 1: Think-aloud interview session

17. How did you use Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners in your think-aloud lesson plan?

It was hard to use play that integrates African culture in teaching mental mathematics. However, I used a game that incorporates numbers to teach learners patterns. Learners played the Dibeke game physically while counting numbers from zero to ten. I think if I knew to use an indigenous game online I would have used it.

18. What role does Africanised play-based pedagogy perform in the online teaching of mental mathematics to FP learners?

It developed their counting skills.

19. Which Africanised play-based activity/activities did you use in the online teaching of mental mathematics to FP learners in your think-aloud lesson?

    I did not use online teaching. I had to choose between online teaching and Africanised play-based activity. I chose an Africanised play-based activity where learners were playing a Dibeke game.

20. Describe any workshop, legislative framework, teaching, and learning theory/theories or strategy that influenced your think-aloud lesson.

I integrated policies, strategies and a theory. Because all of these things serve as guidance for teachers. Without these components, a lesson cannot be developed. It was challenging the first time I had to teach these students, but I believe that after attending training, teaching and learning were improved. Additionally, you must follow CAPS guidelines. They should probably be integrated because they can help you become a better teacher. Understanding the kinds of learners to whom you will be delivering the content is another important step.

Session 2: Stimulated Recall Interview

21. What are your thoughts about your lesson? What went well and wrong?

I think it went well. However, it was not a lesson I had imagined during the think-aloud interview session. I used the NECT lesson plan, but it does not include Africanised play-based pedagogy or online teaching.

22. During your think-aloud interview, you mentioned that the role of using Africanised play-based pedagogy is to develop their counting skills. Do you think you assisted in achieving this role?

We did not use play, but through counting backward and forward learners developed counting skills.

23. If you were given the chance to teach the lesson again, how would you improve it?

I would improve by incorporating online teaching.

24. What did you learn from your lesson that will assist you in using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners in the future?

By incorporating online games that incorporate culture.

APPENDIX I: A SAMPLE OF DOCUMENT DATA FROM S1FPE3

Question	comment
Did the educator use Africanised play-based pedagogy in the planning of the lesson?	No
How did the educator use Africanised play-based pedagogy when planning mental mathematics activities?	The educator did not use Africanised play-based pedagogy when planning mental mathematics activities. Instead, the educator used the NECT lesson plan to guide her lesson preparation. I assume that it is because NECT does not incorporate any Africanised play-based activity for today's lesson.
Did the educator plan to use Africanised play-based activities in the online teaching? If yes, how?	No
Did the educator follow any legislative framework in planning the lesson? If yes, which one?	Yes, CAPS
Did the educator infuse any teaching and learning theory in planning?	No
Did the educator follow any strategy that encourages the use of Africanised play-based pedagogy in the online teaching of mental mathematics activities when planning lessons?	No. The educator mentioned during the interviews that they do not have any strategy that guides them on the use of Africanised play-based pedagogy in the online teaching of mental mathematics activities.
How did the educator plan to stimulate the role of Africanised play-based pedagogy in teaching mental mathematics?	The educator used a Sudoku game for remedial activities. The role of the games in her lesson was to develop learners' mathematical thinking skills.
Which African play-based activities did the educator use in the online teaching of mental mathematics?	Sudoku
Did the learner score all the marks to indicate that Africanised play-based activities assisted them?	Not all of them. I would say a probability of three out of four got all the marks

APPENDIX J: A SAMPLE OF OBSERVATION DATA FROM S3FPE3

Name of participant(pseudonym): S3FPE3

Name of School: School 3

Observation date: 24 January 2024

Observation question	Yes/No	Comment
Did the educator implement the lesson she was verbally articulating in think-aloud interviews?	Yes	Not all of the information shared in the interviews was put into practice; the teacher showed a video of Diketo. However because the other teacher had reserved learners' tablets for their class activities, the learners did not have any technological devices
Did the educator use Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners in your think-aloud lesson plan?	Yes	A Diketo game was used
How did the educator use Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners in your think-aloud lesson plan?		To help learners with counting skills, the teacher played a video of the indigenous game Diketo. They participated in separate teams. Using paper and bottle tops, they were engaging in physical play. During the Diketo game, students were told to choose a leader. A song from YouTube was shown by the teacher via a link. The teacher assisted students with number names and symbols by showing them several films. Links to the resources are included. The educator's usage of a film in Sepedi was more fascinating because it African language that they use for teaching and learning mathematics in the FP. The educator demonstrated videos from Thutong website

What role does Africanised play-based pedagogy perform in the online teaching of mental mathematics to FP learners?		Learners were allowed to interact with one another and strengthen their problem-solving abilities, socialise and use mathematical reasoning
Were problem-solving skills evident in the use of Africanised play-based pedagogy performed in the online teaching of mental mathematics to FP learners?	Yes	Yes, while playing the Diketo game, the learners were able to perform number patterns
Which Africanised play-based activity/activities did you use in the online teaching of mental mathematics to FP learners?		Diketo. Nevertheless, this game can only be played physically—not online
Did the educator refer to the legislative framework/curriculum policy in the implementation of the lesson?	Yes	NECT, CAPS and ATP

APPENDIX K: A CODE BOOK FROM NVIVO 14

A Code Book

"Using Interpretative Phenomenological Analysis"

Title of the study: Using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners.

Codes	Description	Files	References
The use		95	296
Africanised play-based pedagogy	These codes emerged from the main research question of this study to see how educators use Africanised play-based pedagogy in the FP	21	51
Mental mathematics		17	96
Online teaching		17	83

Theme 1: Using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners

This theme links with the main research question that asks how can Africanised play-based pedagogy be used in the online teaching of mental mathematics learners?

Codes	Description	Files	References
The role	The code shows where educators use play-based pedagogy that integrate African culture	43	89

Theme 2: The role of Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners

This theme is aligned with the research sub-Question 2 that asked what the role of Africanised play-based pedagogy be used in the online teaching of mental mathematics to FP learners.

Codes	Description	Files	References
Suitable play-based activities	Used to find play-based activities that could be used in the online teaching of mental	6	16

Theme 3: Suitable African play-based activities in the online teaching of mental mathematics to FP learners

This theme speaks to research sub-question 3 that asked what suitable African play-based activities in the online teaching of mental mathematics to FP learners are.

Codes	Description	Files	References
Legislative framework	This code is used to find out the legislative frameworks that educators when using Africanised play-based pedagogy in the FP	15	19

Theme 4: Legislative frameworks guiding educators on the use of Africanised play-based pedagogy in the FP

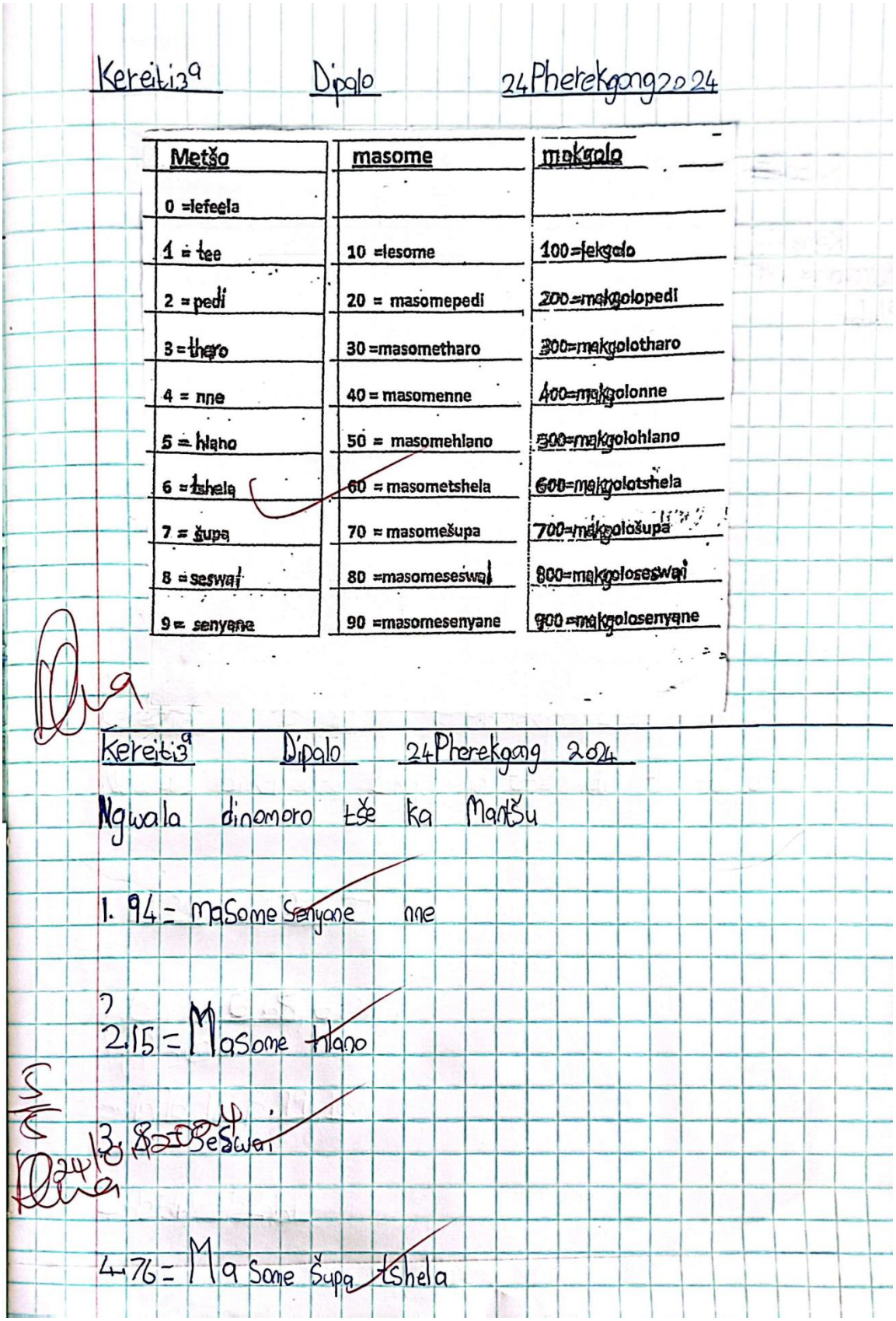
This theme addresses the research sub-question 4 that asked what legislative frameworks guides educators on the use of Africanised play-based pedagogy in the FP teaching.

Codes	Description	Files	References
Strategies	Strategies, workshop, training and guidelines that educators use that guides them in using Africanised play-based pedagogy	15	15

Theme 5: Strategies that educators use to support learners when using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners

This theme links with the research sub-question 5 that asked what strategies support educators when using Africanised play-based pedagogy in the online teaching of mental mathematics to FP learners

APPENDIX L: A SAMPLE OF LEARNERS' ACTIVITY BOOK FROM S4FPE3'S CLASSROOM



Kereiti3ª Dipalo 24 Pherekgong 2024

Metšo	masome	makgolo
0 = lefeela		
1 = tee	10 = lesome	100 = lekgolo
2 = pedi	20 = masomepedi	200 = makgolopedi
3 = tharo	30 = masometharo	300 = makgolotharo
4 = nne	40 = masomenne	400 = makgolonne
5 = hlano	50 = masomehlano	500 = makgolohlano
6 = tshela	60 = masometshela	600 = makgolotshela
7 = šupa	70 = masomešupa	700 = makgološupa
8 = seswai	80 = masomeseswai	800 = makgoloseswai
9 = senyane	90 = masomesenyane	900 = makgolosenyane

Kereiti3ª Dipalo 24 Pherekgong 2024

Ngwala dinomoro tše ka mantšu

1. 94 = maSome Senyane nne

2. 215 = MaSome hlano

3. 8 = seswai

4. 76 = Ma Some Šupa tshela

APPENDIX M: A SAMPLE OF EDUCATORS' LESSON PLAN FROM S3FPE3

5. DITHUŠATHUTO

Pukutšhomo ,pukungwalelwa ,tšhate ya dinomoro , letlakala la kriti.

LETSATSI 3

1. GO BALELA : Go balela pele le morago ka 1 : 165_400.
2. MMETSE WA KGOPOLO

Fokotša 1

16 = (15)

89 = (88)

33 = (32)

49 = (48)

3.DITENG

MEŠONGWANA

- Bea dikaratana tša dinomoro tše letlapeng .(go ba o ka no di ngwala).
  161 , 114 , 175 ,137 , 149 , 109 .
- Ngwala /bea di karata tša mainapalo mo letlapeng , ka godi hlakahlakantšha. Mohl : lekgolomasomešupahlano

  NECT letl : 28 mošongwana 2.
- Ere barutwana ba nyalantšhe dinomoro le mainapalo.mohl :

168 = lekgolo masometshelaseswai

- Aba di balele godimo ge ba di nyalantšha.
- Ba rute go hlahlamolla dinomoro-3 (3 – digit) .NECT letl ; : 28 mošongwana 3.
- Ba fe dinomoro :mohl: 234 = 200 + 30 + 4

4.MOSOMO WA PHAPHUŠI

Ngwala mainapalo .

111 =

118 =

Ngwala ka dinomoro .

Lekgololesomepedi =

Lekgolomasomehlanonne =

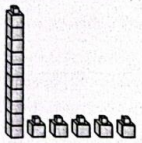
APPENDIX N: A SAMPLE OF LESSON PLAN FROM NECT

Activity 1: Whole class activity

- Learners use their 100 square (see *Printable Resources*).
- Call out number names randomly, and ask learners to point to the correct symbols. Include pairs of numbers where the digits have been reversed, e.g. 19 and 91, 57 and 75 and teen and ten numbers that sound similar, e.g. 19 and 90, 70 and 17.

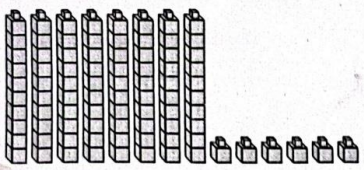
Activity 2: Whole class activity

- Use flash cards to revise the following number names – **show the cards and read the names together.**
  - **zero** to **nineteen** .
  - **twenty** to **ninety**
- Demonstrate the break-down of 2-digit numbers into tens and units, using base ten blocks. Be sure to demonstrate a range of numbers, with different digits in the tens and units positions.
- For example: 15 represented (shown) using base ten bocks is:



(1 ten and 5 units which we write in numerals as 15.)

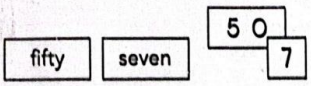
- 86 represented (shown) using base ten bocks is:



(8 tens and 6 units which we write in numerals as 86.)

Activity 3: Learners work in groups

- Give each group a set of 0–99 flard cards and a set of cards with number names as follows: **zero** to **nine, ten** to **ninety** (multiples of **10**) and **eleven** to **nineteen.**
- Ask the groups to show the number **fifty-seven** using flard cards and number name cards, e.g.



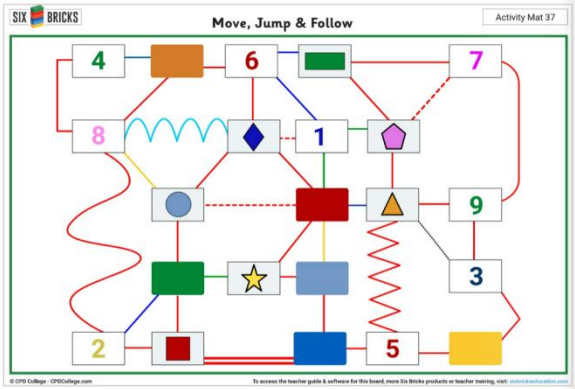
- Show how the flard cards can be used to reveal the tens digit as a tens number. For example in the example above, 5 in the tens place is shown using a '50' card since 5 tens is 50.
- Do the same with the other numbers, e.g. **eighty-nine, twenty-six, seventy-seven, seventy, forty, fourteen, thirty-nine, ninety-three,** etc.
- Make sure that you use the ten numbers together with the teen numbers and look out for learners who confuse these. Discuss the differences and how to read the numbers correctly and interpret what their values are.

4. Classwork activity (25 minutes) (See next page)

5. Homework activity (5 minutes) (See next page)

6. Reflection on lesson

APPENDIX O: SAMPLES OF SIX BRICKS EDUCATORS' GUIDE



There are lots of activities for the Move, Jump & Follow mat. Check out our website www.sixbrickseducation.com for the full range of activities and instructions. The mat consists of a series of colours, numbers, shapes and lines. The teacher calls out 'moves' and the children move their bricks according to the instructions.

Learning outcomes can include but are not exclusive to: Listening skills development, spatial skills development, following instructions, number recognition, sequencing, vocabulary development etc.

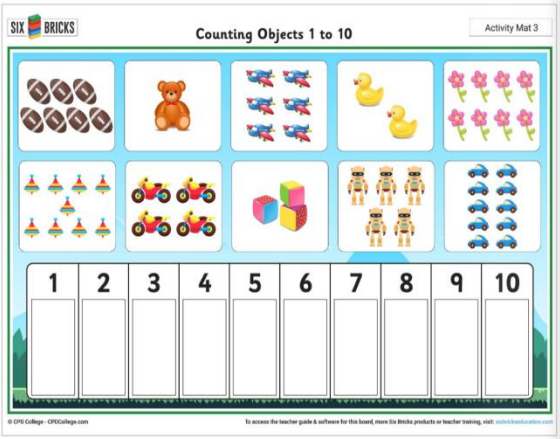
Let us do just one activity as an example of how the mat works.

Up & Down, Left & Right - Option 3

01. Place yellow on number 3
02. move up
03. move left
04. move up
05. move left
06. move down
07. move to the circle
08. follow line to the diamond
09. follow line left
10. follow line down
11. move right
12. jump to the star
13. move right
14. move up
15. move up
16. move to the pentagon
17. move down
18. move right
19. move down
20. follow dotted line

"What block have you ended on?" (The Triangle)

There are lots more sets of instructed activities for this mat to be found on our website – just visit www.sixbrickseducation.com and you'll find everything there.



Children need lots of experience in counting sets of objects, comparing sets, ordering sets and combining sets. Using the Six Bricks Counting Objects 1-10 activity mat, every teacher can engage children in lots of counting and problem-solving activities while conversing in the language of mathematics.

Learning objectives

The child should be enabled to -

- Count the number of objects in a set, 1-10 e.g. how many footballs are there in the box?
- Count regular arrays or rows before random groups e.g. let's count to see how many cars?
- Compare non-equivalent sets 1-10 e.g. which is more, motorbikes or more cubes?
- Order sets of objects by number, 1-10 e.g. the smallest number is the teddy set, just 1; next are the 2 ducks, then the 3 cubes, which set would be next?

Teacher questions

- How many rugby balls are in the first box? Mark the number on the number line with a brick.
- How many pink flowers are in the box? Indicate on the number line.
- How many aeroplanes can you see? Show the number on the number line.
- Place red bricks on the boxes that have more than 5 things in them.
- Place yellow bricks on the boxes that have less than 4 things in them.
- Which two groups could you combine to make 5?
- How many brown teddies can you see? Mark the number on the number line.
- How many pink flowers are in the box? Mark the number on the number line.
- How many yellow ducks are in the box? Mark the number on the number line.
- How many spinning tops can you see? Mark the number on the number line.
- How many motorbikes are in this box? Mark the number on the number line.
- How many coloured cubes are in this box? Mark the number on the number line.
- How many cars can you see? Mark the number on the number line.
- How many aliens are in this box? Mark the number on the number line.
- On the top row, use your interactive whiteboard pen to draw an outline around the ducks, aeroplanes and teddy to form one larger set. How many things in this set? Mark the answer on the number line with a yellow brick.
- If I combine the aeroplanes and the ducks, how many things will I have altogether? Show me that number on the number line.
- There are 10 cars in this box. If I took 2 away, how many would be left? Place a brick to show me the answer on the number line.
- Place a yellow brick on 6. Now place another yellow brick on a box with 6 things in it.
- Place a red brick on 9. Now place a matching red brick on a box with 9 things in it.
- Continue placing other brick colours on numbers and matching brick colours to its equivalent matching set of objects

This is a simple activity mat, but when combined with Six Bricks, the the interactive whiteboard (IWB) software, creative application, and skillful questioning by you the teacher, well it becomes a great tool to build number skills and concepts up to 10.

APPENDIX P: TURNITIN CONFIRMATION REPORT

PAPER NAME	AUTHOR
Mmakgabo Selepe Thesis.docx	MMAKGABO ANGELINAH SELEPE
WORD COUNT	**CHARACTER COUNT**
67014 Words	412561 Characters
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256 Pages	23.9MB
SUBMISSION DATE	**REPORT DATE**
Apr 25, 2024 12:58 AM GMT+2	Apr 25, 2024 1:03 AM GMT+2

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- Crossref Posted Content database
- 7% Submitted Works database

Excluded from Similarity Report

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APPENDIX Q: CONFIRMATION OF PROFESSIONAL EDITING

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Website: www.jaybe9.wixsite.com/bluediamondsediting

25 May 2024

Declaration of editing

USING AFRICANISED PLAY-BASED PEDAGOGY IN THE ONLINE TEACHING OF MENTAL MATHEMATICS TO FOUNDATION PHASE LEARNERS
by
MMAKGABO ANGELINAH SELEPE

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

I am qualified to have done such editing, being in possession of a Bachelor's degree with a major in English, having taught English to matriculation, and having a Certificate in Copy Editing from the University of Cape Town. I have edited more than 500 Masters and Doctoral theses, as well as articles, books and reports.

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

Sincerely,

Baumgardt

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Jacqui Baumgardt
Full Member

Membership number: BAU001
Membership year: March 2024 to February 2025

+44 7895146059
jacquibaumgardt@gmail.com
https://jaybe9.wixsite.com/bluediamondsediting

www.editors.org.za

ciep Intermediate Member