UNIVERSITY OF EDUCATION, WINNEBA

IMPLEMENTATION OF PLAY-BASED PEDAGOGY IN NUMERACY INSTRUCTIONS IN EARLY CHILDHOOD CENTRES IN THE NSUAEM CIRCUIT

PERPETUA FOKUOH SARKODIE

(7251900014)

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DECLARATION

Student's Declaration

I, **PERPETUA FOKUOH SARKODIE,** declare that this thesis is a result of my original research except for references to other people's work which have been duly acknowledged and it has neither in whole nor in part been presented for another degree in this university or elsewhere.

Candidate's Signature: …….

Date: ……..

Supervisor's Declaration

I hereby declare that the preparation and supervision of this research work were done in accordance with the guidelines for the supervision of research work as laid down by the School of Graduate Studies, University of Education, Winneba.

Name of Supervisor: Professor Clement Ali (Ph.D.)

Supervisor's Signature: …….

Date: ……

DEDICATION

To my lovely Family

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ABSTRACT

The purpose of this study was to examine the implementation of play-based pedagogy in numeracy instruction within early childhood centres in the Nsuaem Circuit. The study adopted an interpretivist paradigm with an exploratory case study design. the population of the study was of 78 kindergarten teachers in 22 early childhood centres. The purposive sampling technique was used to select 14 kindergarten teachers in the Circuit. Semi-structured interview was the data collection instrument used in this study. The data from the study were analysed using thematic analysis to identify key patterns and themes. The findings revealed that educators view play-based pedagogy as effective for engaging learners, enhancing understanding, simplifying instruction, and promoting child-centred learning. The findings further revealed that kindergarten teachers in the Nsuaem Circuit commonly use counting games, storytelling, pattern recognition, shape activities, and measurement play to teach numeracy. It was also revealed that play-based pedagogy enhances numeracy by promoting hands-on learning, supporting diverse learning styles, encouraging critical thinking, and aligning with children's developmental needs. Moreover, the findings revealed that kindergarten teachers in the Nsuaem Circuit face major challenges in implementing play-based numeracy instruction, including inadequate resources, insufficient training, large class sizes, limited time, and a lack of parental support. The study therefore recommends that the Tarkwa Nsuaem Municipal Education Directorate and related bodies prioritize continuous professional development to help teachers understand and consistently implement structured play-based approaches. Again, there should be the provision of adequate teaching materials, classroom expansion, reduced learner-to-teacher ratios, and time allocation for meaningful play.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The early years of a child's education are crucial for developing foundational numeracy skills, and play-based pedagogy has been widely recognized as an effective instructional approach in early childhood education (Pyle et al., 2023). Play-based learning in numeracy instruction allows children to explore mathematical concepts in an engaging, hands-on manner, fostering deeper understanding and retention (Kagan et al., 2022). Despite the proven benefits, the implementation of play-based pedagogy in numeracy instruction varies across different contexts, including in Ghana, where structured teaching approaches continue to dominate many early childhood centres (Osei-Poku & Adu-Gyamfi, 2023). This study examines the implementation of play-based pedagogy in numeracy instruction in early childhood centres within the Nsuaem Circuit, focusing on educators' knowledge, commonly used play-based activities, the effectiveness of these approaches, and the challenges encountered.

The global shift towards learner-centred and interactive teaching methodologies has placed play-based pedagogy at the forefront of early childhood education policies (UNESCO, 2023). Play-based approaches have been endorsed as a best practice by various international educational bodies, including UNICEF and the World Bank, due to their potential to develop problem-solving, critical thinking, and numeracy skills in young learners (Lester & Russell, 2023). However, in many African contexts, including Ghana, traditional rote learning methods still predominate, often leading to a lack of deep conceptual understanding in numeracy among early learners (Adjei et al., 2023). This study seeks to examine how play-based pedagogy is being implemented in numeracy

instruction in the Nsuaem Circuit and the extent to which educators are equipped with the necessary knowledge and resources to effectively facilitate play-based learning.

Teachers' understanding of play-based pedagogy significantly impacts its implementation and effectiveness in early childhood classrooms. Research indicates that educators who have undergone adequate training in play-based methods are more likely to integrate such practices into their teaching (Fuller et al., 2023). However, in Ghana, many kindergarten teachers lack specialized training in play-based learning strategies, which hinders their ability to implement them effectively in numeracy instruction (Nyarko & Tamanja, 2023). The study will explore the extent of educators' knowledge in the Nsuaem Circuit, identifying gaps in their understanding and the need for professional development in this area.

Play-based pedagogy incorporates various activities that enhance children's engagement with numeracy concepts. Activities such as counting games, block building, role-playing, and puzzle-solving have been identified as effective strategies for improving mathematical reasoning in young learners (Sarama & Clements, 2023). However, the specific types of play-based activities used by teachers in the Nsuaem Circuit remain largely undocumented. This study will investigate the kinds of play-based activities employed in early childhood centres, assessing their alignment with national curriculum guidelines and their effectiveness in fostering numeracy skills.

Several studies highlight the benefits of play-based pedagogy in enhancing numeracy skills by allowing children to apply mathematical concepts in real-world scenarios (Baroody et al., 2023). Through hands-on exploration and social interaction, learners develop problem-solving abilities and conceptual understanding beyond mere memorization (Hassinger-Das et al., 2023). However, the effectiveness of play-based approaches in the specific context of the Nsuem Circuit remains unclear. This study will assess how play-based pedagogy influences numeracy skill acquisition

among kindergarten learners, determining whether it leads to improved learning outcomes compared to traditional teaching methods.

Despite its advantages, implementing play-based pedagogy comes with significant challenges, particularly in resource-constrained environments. Teachers often struggle with inadequate learning materials, large class sizes, and limited training opportunities (Arkorful et al., 2023). In Ghana, many early childhood educators face pressure to adhere to formal teaching structures that emphasize direct instruction over interactive learning (Mensah et al., 2023). Additionally, the lack of parental and administrative support for play-based learning further complicates its implementation (Owusu & Boateng, 2023). This study will investigate the specific obstacles educators in the Nsuem Circuit face when incorporating play-based numeracy instruction and propose strategies to address these challenges.

This study is significant as it contributes to the growing body of research on play-based pedagogy in early childhood numeracy instruction. By focusing on the Nsuaem Circuit, the research provides localized insights that can inform educational policies and teacher training programs. Findings from this study will aid curriculum developers, policymakers, and educators in identifying effective strategies for integrating play-based learning into early childhood numeracy instruction, ultimately improving learning outcomes for young learners.

The implementation of play-based pedagogy in numeracy instruction has been widely endorsed as a means to foster meaningful learning experiences in early childhood education. However, the extent to which this approach is effectively applied in Ghana, particularly in the Nsuem Circuit, remains underexplored. This study aims to bridge this gap by examining educators' knowledge, the types of play-based activities used, the effectiveness of these approaches, and the challenges encountered in their implementation. By addressing these key areas, the study will contribute to

strengthening play-based numeracy instruction in early childhood education and provide recommendations for improving teaching practices in Ghanaian kindergarten classrooms.

1.2 Statement of the Problem

The effective implementation of play-based pedagogy in early childhood numeracy instruction is often constrained by several factors, including inadequate teacher preparation, limited resources, and a lack of institutional support (Tsigari et al., 2023). While research has established that play-based learning enhances children's conceptual understanding of numeracy (Pyle & Danniels, 2023), many educators in Ghana, particularly in the Nsuaem Circuit, still rely heavily on rote memorization and teacher-directed instruction. This traditional approach often results in limited engagement and a superficial understanding of mathematical concepts among early learners (Osei-Poku et al., 2023).

One of the major issues affecting play-based pedagogy in numeracy instruction is the insufficient knowledge and training among teachers. Many kindergarten educators in Ghana have limited exposure to modern play-based methodologies, which affects their confidence and ability to integrate these strategies effectively in their teaching (Nyarko & Tamanja, 2023). Additionally, the lack of appropriate teaching and learning materials further restricts the successful implementation of play-based numeracy instruction (Arkorful et al., 2023). Without adequate resources such as counting blocks, number puzzles, and interactive learning tools, teachers struggle to create engaging and meaningful play-based numeracy activities.

Furthermore, play-based pedagogy requires a supportive learning environment that allows for flexibility and creativity. However, overcrowded classrooms and rigid curriculum structures in many Ghanaian early childhood centres make it challenging for teachers to implement play-based methods effectively (Mensah et al., 2023). There is also a prevalent perception among some parents

and administrators that play-based learning is less effective compared to traditional direct instruction, further hindering its adoption (Owusu & Boateng, 2023).

The ideal practice, as recommended by international early childhood education frameworks, involves integrating structured and unstructured play activities into daily numeracy instruction to enhance problem-solving and critical thinking skills (UNESCO, 2023). However, existing literature lacks comprehensive studies on how play-based numeracy instruction is applied within the Ghanaian context, particularly in the Nsuaem Circuit. Most research on play-based learning in early childhood education has been conducted in Western contexts, leaving a significant geographical and contextual gap in understanding how these approaches work in resource-limited environments (Lester & Russell, 2023).

This study aims to bridge these gaps by providing empirical evidence on the state of play-based pedagogy in numeracy instruction in the Nsuem Circuit. By examining teachers' knowledge, common play-based activities, their effectiveness, and existing challenges, the study will offer insights into how best to improve play-based numeracy instruction in Ghanaian early childhood centres.

1.3 Purpose of the Study

The purpose of this study is to examine the implementation of play-based pedagogy in numeracy instruction within early childhood centres in the Nsuaem Circuit.

1.4 Research objectives

The following objectives guided the study

1. To explore the views of early childhood educators in the Nsuaem Circuit to implement play-based pedagogy in numeracy instruction.

2. To identify the specific play-based activities that are most commonly used to teach numeracy concepts in kindergarten classrooms in the Nsuaem Circuit.
3. To assess the effectiveness of play-based pedagogical approaches in enhancing numeracy skills among kindergarten learners in early childhood centres within the Nsuaem Circuit
4. To explore the challenges faced by educators in the Nsuaem Circuit in the implementation of play-based pedagogy in numeracy instruction.

1.5 Research Questions

The following research questions were formulated for the study

1. What is the level of knowledge early childhood educators in the Nsuaem Circuit have about implementing play-based pedagogy in numeracy instruction?
2. What types of play-based activities are most commonly used by teachers to teach numeracy concepts in kindergarten classrooms in the Nsuaem Circuit?
3. How effective are play-based pedagogical approaches in enhancing numeracy skills among kindergarten learners in early childhood centres within the Nsuaem Circuit?
4. What challenges do educators face in implementing play-based pedagogy in numeracy instruction in the Nsuaem Circuit?

1.6 Significance of the Study

This study is significant in multiple dimensions, contributing to policy formulation, educational practice, and theoretical advancement in early childhood education.

Findings from this study will provide valuable insights for policymakers in Ghana's education sector, particularly those involved in early childhood curriculum development. By assessing the implementation of play-based pedagogy in numeracy instruction, the study will highlight key challenges that hinder its effective adoption. The results can inform the Ministry of Education,

Ghana Education Service, and other stakeholders in making evidence-based decisions to refine policies related to early childhood numeracy instruction. Additionally, the study may contribute to the revision of teacher training programs by incorporating more comprehensive play-based learning strategies into professional development initiatives.

For educators and school administrators, this study will offer practical guidance on enhancing numeracy instruction through play-based pedagogy. Teachers will gain a deeper understanding of effective play-based methods, allowing them to adopt interactive teaching strategies that improve numeracy skills in young learners. The study will also provide recommendations on resource allocation and teacher training, equipping schools with strategies to address challenges such as limited instructional materials and large class sizes. Furthermore, parents and caregivers will benefit from an improved understanding of the role of play in numeracy development, fostering better home-school collaboration in supporting children's learning.

This study will contribute to the growing body of knowledge on play-based pedagogy, particularly in the Ghanaian early childhood education context. By examining its effectiveness in numeracy instruction, the study will validate existing theories on play-based learning and may identify new frameworks that can further enhance its application. Findings will also address gaps in the literature regarding localized challenges in implementing play-based numeracy instruction, setting the stage for future research.

1.7 Delimitations of the Study

The study is geographically delimited to early childhood education centres in the Nsuaem Circuit, focusing on educators' experiences in this specific context. The study focuses on the implementation of play-based pedagogy in numeracy instruction, specifically examining teachers' knowledge, the types of play-based activities used, their effectiveness, and the challenges

encountered. The research examines early childhood education settings, emphasizing how play-based methods are integrated into numeracy instruction in Ghanaian kindergarten classrooms. A qualitative research approach will be adopted, utilizing interviews, classroom observations, and focus group discussions to gather in-depth data on play-based pedagogy in numeracy instruction.

1.8 Operational Definition of Terms

The following terms were operationally defined;

Play-Based Pedagogy – A teaching approach that integrates play activities into instructional practices to facilitate learning and skill development among young learners

Numeracy Instruction – The process of teaching mathematical concepts such as counting, number recognition, addition, subtraction, and problem-solving skills in early childhood education

Early Childhood Education – The formal and informal educational experiences provided to children from birth to age eight, with a focus on foundational skill development.

Educators' Knowledge – The level of understanding, skills, and competencies that teachers possess regarding the implementation of play-based learning strategies in numeracy instruction.

Play-Based Activities – Structured or unstructured interactive learning tasks, such as counting games, puzzles, role-playing, and block-building, are designed to enhance numeracy skills.

Effectiveness of Play-Based Pedagogy – The extent to which play-based teaching approaches improve learners' engagement, conceptual understanding, and application of numeracy concepts in real-life situations.

Nsuaem Circuit – A specific educational jurisdiction in Ghana where the study focuses on assessing play-based pedagogy in early childhood numeracy instruction.

1.9 Organisation of the Study

The study is structured into five chapters. The first chapter presents the background of the study, statement of the problem, purpose, and objectives, along with the research questions. It also outlines the significance, delimitations, and limitations of the study, the operational definition of terms, and the organization of the study. Chapter two focuses on the conceptual framework, theoretical perspectives, and a review of relevant empirical studies that inform the research. The third chapter details the research methodology, including the research paradigm, approach, and design. It also discusses the population, sampling methods, data collection instruments, and the reliability and trustworthiness criteria. Additionally, the chapter describes the procedures used for data collection and the methods of data analysis. The fourth chapter dealt with the findings and their discussion. The fifth and final chapter contains a summary, conclusions, and recommendations.

Chapter four presents and analyzes the research findings. The results are categorized into two sections: the first covering demographic data and the second focusing on the main study findings.

The final chapter summarizes the study, draws conclusions, and provides recommendations. It also suggests potential areas for further research.

CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

This chapter focused on reviewing related literature on the study's specific objectives. Literature was reviewed on the following sub-headings:

- Sociocultural learning theory by Lev Vygotsky (1896–1934)
- Experiential learning theory by **(John Dewey)**

Conceptual Review

- Concept of play
- Play in early childhood education
- Benefits of play

Empirical Review

- Teachers' Knowledge of the Implement Play-based Pedagogy in Numeracy Instruction.
- Types of Play-based Activities Used in Numeracy Instructions
- Effectiveness of Play-based Pedagogical Approaches in Enhancing Numeracy Skills
- Challenges Early Childhood Educators Encounter in Implementing Play-based Pedagogy

2.1 Theoretical Framework

Sociocultural Theory of Play (Lev Vygotsky)

The Sociocultural Theory of Play, developed by Lev Vygotsky (1896–1934), emphasizes the influence of social, cultural, and historical factors on cognitive development through social interactions (Vygotsky, 1978; Bodrova & Leong, 2007). Vygotsky, a contemporary of Piaget, was particularly interested in how children learn and how learning fosters development (Fleer, 2010;

Rogoff, 2003). He argued that a child's cognitive growth is rooted in engagement with their culture and social environment (Daniels, 2008; Wertsch, 1991).

Vygotsky viewed play as a primary vehicle for knowledge construction, allowing children to develop cognitively while interacting with their surroundings (Smagorinsky, 2011; Bodrova, 2008). He introduced the concept of the Zone of Proximal Development (ZPD), suggesting that children achieve higher levels of competence when guided by more knowledgeable peers or adults (Vygotsky, 1978; Chaiklin, 2003). Within this zone, children can accomplish tasks beyond their independent abilities with the support of scaffolding provided by caregivers and teachers (Wood, Bruner, & Ross, 1976; Mercer & Howe, 2012).

Vygotsky identified two key purposes of play. The first purpose involves pretend or fantasy play, in which children create their own realities and engage in symbolic thinking (Nicolopoulou, 2010; Berk, Mann, & Ogan, 2006). For instance, if a child desires to drive a car but cannot, they might pretend to drive instead, symbolizing the development of abstract thought (Bodrova & Leong, 2015; Harris, 2000). This ability to use objects symbolically such as pretending a branch is a horse demonstrates how play fosters cognitive flexibility and linguistic meaning-making (Göncü & Gaskins, 2011; Van Oers, 2013).

The second purpose of play, according to Vygotsky, arises from the first and involves rules and social roles (Smith, 2010; Lillard, 2017). As children engage in role-playing, they develop structured behaviors, only allowing participation from peers who adhere to the imagined scenario (Göncü, Tuermer, Jain, & Johnson, 1999; Dunn, 2004). Adults can enter this world of play to scaffold children's understanding by guiding and enriching their experiences (Roskos & Christie, 2013; Siraj-Blatchford, Sylva, Muttock, Gilden, & Bell, 2002).

Sociocultural theory, also known as cultural-historical psychology, conceptualizes the development of higher mental functions as fundamentally social, emphasizing interaction as the foundation of learning and communication (Cole, 1996; Daniels, 2001). Rooted in the writings of Marx and Engels, Vygotsky's theory (1978) highlights how cognitive processes are shaped by cultural tools and social experiences (Rogoff, 2003; Wertsch, 1991). His contributions continue to shape contemporary understanding of play as a culturally mediated activity essential for cognitive growth.

A fundamental aspect of sociocultural theory is its emphasis on learning as a social process, where meaning is constructed through language and interaction within a given social context (Lantolf, Thorne, & Poehner, 2015; Vygotsky, 1978). Unlike cognitive theories that focus on mediation between stimulus and response, Vygotsky's (1978) theory examines the social context in which learning occurs, asserting that psychological structures are not inherent but are formed through interaction with the social environment (Daniels, 2016; Mercer & Howe, 2012). In other words, the development of mental functions is inextricably linked to social engagement, particularly through collaborative learning experiences (Zhao & Chan, 2021; Fleer, 2020).

According to Polly et al. (2017), sociocultural theory positions learners as active constructors of their learning environment. Similarly, Lee and Hannafin (2016) argue that learners are not just passive recipients of knowledge but engage dynamically with their surroundings, which in turn nurtures and scaffolds their learning (Aimin, 2013; Chen et al., 2021). This perspective underscores the reciprocal relationship between teachers and learners. As highlighted by Sullivan and Wilson (2022), teachers actively shape their instructional strategies based on their understanding of students' learning needs, thereby creating an adaptive and responsive learning environment.

One of the key tenets of sociocultural theory is its emphasis on learning as a collective activity, rather than an individual endeavor (Li, 2019; Newman, 2018). Scholars such as Behroozizad, Nambiar, and Amir (2014) argue that learning occurs through participation in shared cultural and social practices. De Valenzuela (2014) further clarifies that sociocultural theory differs from other perspectives, such as constructivism, by prioritizing the social context over individual cognition. In this light, play-based pedagogy in numeracy instruction fosters cooperative learning environments, where children develop problem-solving skills by engaging in structured, yet flexible, play activities (Zhang, Fanyu, & Du, 2013; Fleer & Pramling, 2015).

Vygotsky's Zone of Proximal Development (ZPD) is a critical component of this theory, illustrating how children learn best when assisted by a more knowledgeable other (Wood, Bruner, & Ross, 1976; Lantolf & Thorne, 2020). Within early childhood numeracy instruction, educators play a facilitative role, providing guidance that enables children to gradually develop independent mathematical reasoning (Edwards, 2017; Siraj-Blatchford et al., 2020). This scaffolding process is dynamic, as teachers withdraw support when learners demonstrate autonomous problem-solving abilities (Verenikina, 2018; Mercer, 2021).

Moreover, play-based numeracy instruction aligns with Vygotsky's notion that cognitive functions develop on two planes first socially and then individually (Ellis & Barkhuizen, 2005; Vygotsky, 1981). Initially, mathematical concepts are explored collaboratively, through guided play with peers or teachers, before becoming internalized as independent thought processes (Tudge & Scrimsher, 2022; Rogoff, 2003). This transition from social regulation to self-regulation is a key objective of effective numeracy instruction (Van Oers, 2013; Smith, 2020).

In conclusion, sociocultural theory provides a robust framework for understanding how play-based pedagogy can enhance numeracy instruction in early childhood education. By emphasizing the

social nature of learning, it encourages collaborative problem-solving, guided discovery, and the gradual internalization of mathematical concepts (Fleer, 2020; Lantolf & Poehner, 2021). Through scaffolded interactions, children develop essential numeracy skills that contribute to their cognitive growth and academic success.

Zone of Proximal Development (ZPD) and Scaffolding

The Zone of Proximal Development (ZPD) is a central concept in educational psychology, originally introduced by Vygotsky in the 1930s. It plays a crucial role in sociocultural learning theory, which emphasizes the impact of social interaction on cognitive growth (Daniels, 2016; Mercer, 2021). The ZPD represents the gap between what a learner can accomplish independently and what they can achieve with the support of a more knowledgeable individual, such as a teacher, peer, or caregiver (Liu & Matthews, 2005; Tudge & Scrimsher, 2022). This principle highlights the role of scaffolding, where guidance is gradually withdrawn as the learner gains competence, allowing for independent mastery of new skills (Hammond & Gibbons, 2005; Verenikina, 2018). Over time, the ZPD has significantly influenced instructional strategies that emphasize active participation, collaboration, and guided discovery learning (Van de Pol, Volman, & Beishuizen, 2010; Wood, 2021).

Understanding the ZPD

Vygotsky described the ZPD as the range between a learner's current ability level and their potential development when assisted by a more skilled individual (Chaiklin, 2003; Lantolf & Thorne, 2020). This framework underscores the idea that learning is not an isolated process but rather one that emerges through meaningful social engagement and cooperative problem-solving (Holton & Clarke, 2006; Mercer & Howe, 2012). Essentially, the ZPD identifies areas where

learners are on the verge of grasping new concepts but require structured support to advance (Shabani, Khatib, & Ebadi, 2010; Fleer, 2020).

For instance, in a numeracy-focused early childhood classroom, a child may be proficient in basic arithmetic but struggle with multiplication. Through guided instruction—whether from a teacher, peer, or interactive learning tool the child receives the necessary supportive interventions to process and eventually master more advanced operations (Bliss, Askew, & Macrae, 1996; Smith, 2020). This gradual shift from assisted to independent problem-solving exemplifies the ZPD in action and highlights the importance of structured, responsive teaching methods (Walqui, 2006; Tzuriel, 2021).

By leveraging the ZPD and scaffolding techniques, educators can design instruction that fosters deeper engagement, encourages exploration, and promotes long-term cognitive development (Van Oers, 2013; Sullivan & Wilson, 2022). These approaches align with modern constructivist and play-based learning models, reinforcing the significance of interactive, student-centered education (Siraj-Blatchford et al., 2020; Edwards, 2017).

Scaffolding

Scaffolding is a crucial instructional approach that aligns with the Zone of Proximal Development (ZPD), facilitating learners' progression toward independent mastery. It refers to temporary support provided by a teacher, peer, or expert to help learners accomplish tasks they cannot yet complete on their own (Wood, Bruner, & Ross, 1976; Hammond & Gibbons, 2005). As learners develop competence, this support is gradually reduced, allowing them to take control of their learning (Van de Pol, Volman, & Beishuizen, 2010; Walqui, 2006). Originally conceptualized by Bruner and

colleagues as an extension of Vygotsky's sociocultural theory, scaffolding emphasizes structured, responsive assistance that fosters cognitive growth (Daniels, 2016; Verenikina, 2018).

Scaffolding can take multiple forms, including modeling, questioning, feedback, and guided prompts (Mercer & Fisher, 1992; Lantolf & Thorne, 2020). The fundamental objective is to adjust the level of assistance based on the learner's needs, ensuring that the task remains challenging yet achievable (Shabani, Khatib, & Ebadi, 2010; Fleer, 2020). For scaffolding to be effective, educators must accurately assess learners' current abilities and structure their support accordingly (Holton & Clarke, 2006; Smith, 2020).

For example, in an early numeracy classroom, a teacher may initially use counting aids or visual representations to help children solve basic arithmetic problems. As learners become more proficient, the teacher gradually removes these supports, encouraging independent problem-solving (Bliss, Askew, & Macrae, 1996; Tzuriel, 2021). Similarly, in a language-learning setting, educators might provide sentence starters or word banks to assist students in constructing sentences. Over time, as learners gain confidence, the support is reduced, allowing them to create sentences independently (Edwards, 2017; Sullivan & Wilson, 2022).

By scaffolding learners within their ZPD, educators create a structured yet flexible learning environment that promotes autonomy, engagement, and deeper conceptual understanding (Siraj-Blatchford et al., 2020; Van Oers, 2013). This gradual transition from guided to independent learning is a fundamental principle of constructivist, play-based, and inquiry-driven educational models (Walqui, 2006; Mercer & Howe, 2012).

Educational Applications of the Zone of Proximal Development (ZPD)

The Zone of Proximal Development (ZPD) has significantly shaped educational practices by promoting instructional strategies that cater to learners' developmental needs. Instead of adhering to a one-size-fits-all approach, educators are encouraged to assess students' individual learning potential and provide targeted support to help them advance (Shabani, Khatib, & Ebadi, 2010; Hammond & Gibbons, 2005). This learner-centered methodology contrasts with traditional teaching models, which often deliver uniform content without considering varying levels of student readiness (Van de Pol, Volman, & Beishuizen, 2010).

One major application of the ZPD in education is differentiated instruction, a teaching strategy that adapts instructional methods and resources to meet students' unique needs. By identifying each learner's ZPD, educators can provide customized challenges and support, ensuring that students are neither understimulated nor overwhelmed (Tomlinson, 2017; Gregory & Chapman, 2021). Differentiated instruction allows for flexible grouping, tiered assignments, and individualized learning paths, enabling learners to progress at their own pace while receiving the necessary scaffolding (Santangelo & Tomlinson, 2012).

Another crucial application is formative assessment, which involves evaluating students' progress during the learning process rather than solely at its conclusion. By continuously monitoring student performance, educators can determine their ZPD and modify instruction accordingly (Black & Wiliam, 2018; Andrade & Heritage, 2022). This iterative feedback loop helps teachers adjust the level of challenge and support, promoting gradual independence and deeper understanding (Munshi et al., 2023; Pollock & Tolone, 2020).

In early childhood education, the ZPD underpins guided play and inquiry-based learning, where educators create engaging, interactive environments that encourage children to explore concepts with just the right amount of assistance (Wood, 2010; Weisberg et al., 2016). This approach aligns with young learners' developmental needs, allowing them to engage in complex thinking and problem-solving through playful, hands-on experiences scaffolded by teachers or more capable peers (Parker & Thomsen, 2019; Lee et al., 2024).

By integrating ZPD-informed strategies into instructional planning, assessment, and learning environments, educators can foster student autonomy, critical thinking, and academic growth, ensuring that all learners receive the personalized support necessary for meaningful development (Mercer & Fisher, 1992; Lantolf & Poehner, 2014).

2.1.2 Experiential Learning Theory (John Dewey)

John Dewey's Experiential Learning Theory remains a foundational framework in education, emphasizing the significance of hands-on experiences in shaping knowledge acquisition. Dewey argued that active engagement in real-world situations fosters deeper understanding and meaningful learning, rather than relying solely on memorization or passive reception of information (Kolb, 2015; Roberts, 2020). His perspective, outlined in works such as *Experience and Education* (1938), has had a profound impact on progressive education, advocating for learning processes that connect theory with practice (Cunningham, 2021).

Core Principles of Experiential Learning

1. Learning Through Experience

A central tenet of Dewey's theory is that knowledge is constructed through direct experience, rather than being passively received. According to Dewey, authentic education occurs when learners

actively engage with their environment and draw meaning from their experiences (Miettinen, 2000; Kolb & Kolb, 2017). Meaningful, relevant experiences serve as the basis for constructing new knowledge, allowing learners to connect prior understanding with new insights (Ord, 2012).

2. Reflective Thinking

Dewey also stressed the role of reflection in experiential learning, arguing that learners must analyze and evaluate their experiences to extract meaning. Reflection enables students to critically assess outcomes and apply their insights to future learning situations (Moon, 2004; Boud, Keogh, & Walker, 2013). Dewey (1933) described reflective thinking as an active and deliberate process that fosters deeper comprehension and critical thinking skills (Rodgers, 2002). This approach helps learners develop the ability to make informed decisions and adapt to new challenges based on past experiences.

3. Continuity and Interaction

Dewey proposed that learning is shaped by two key principles: continuity and interaction. Continuity suggests that each experience builds upon previous ones, influencing an individual's ongoing intellectual development (Glassman, 2001; Roberts, 2020). Interaction highlights the relationship between the learner and their environment, emphasizing that knowledge is constructed through engagement with social and contextual factors (Baker, 2018; Ord, 2012). These principles reinforce the idea that learning is an evolving process, influenced by past experiences and the surrounding environment.

Dewey's Experiential Learning Theory has significantly influenced modern educational practices, including project-based learning, inquiry-based learning, and hands-on activities. By integrating experience, reflection, and interaction, educators can create engaging and meaningful learning

opportunities that foster critical thinking, adaptability, and lifelong learning (Kolb, 2015; Moon, 2004).

Active Engagement

Experiential learning places a strong emphasis on active involvement in the educational process. According to Dewey, learners should engage with concepts, materials, and peers in a meaningful way to construct their own understanding (Kolb & Kolb, 2017; Moon, 2004). This approach contrasts with traditional teacher-centered models that focus on passive information delivery. When students actively participate in learning activities, they take ownership of their knowledge-building process, fostering deeper comprehension and long-term retention (Roberts, 2020).

Collaborative Learning

Dewey also underscored the social dimension of learning, stressing the significance of interaction and collaboration in education. He maintained that learning is inherently communal, where individuals exchange experiences and ideas to expand collective knowledge (Glassman, 2001; Ord, 2012). This perspective supports cooperative learning environments, which encourage dialogue, teamwork, and joint problem-solving, helping learners develop communication skills and critical thinking abilities (Baker, 2018; Miettinen, 2000).

The Role of Experiential Learning in Play-Based Learning

Learning Through Experience

Experiential learning theory highlights the importance of real-world experiences and active engagement in education (Kolb & Kolb, 2018). Play-based learning in kindergarten aligns with this concept by offering hands-on, interactive experiences that promote exploration and discovery

(Jay & Knaus, 2018). Through play, children experiment with new ideas, engage in problem-solving, and develop foundational skills in a meaningful and engaging way (Pyle et al., 2020). This process allows young learners to construct knowledge through direct interaction with their environment.

Development of Critical Thinking and Problem-Solving Skills

Experiential learning encourages active inquiry and reflection, essential components of critical thinking and problem-solving (Moon, 2019). In a play-based setting, children encounter challenges that require them to analyze situations, make decisions, and test solutions (Zosh et al., 2018). Activities such as block building or role-playing enable learners to evaluate different approaches and learn from their experiences, strengthening their cognitive development (Weisberg et al., 2022).

Social Interaction and Collaboration

Learning is a social process, and play-based environments foster collaboration and communication among children (Edwards, 2021). Through group activities, children develop interpersonal skills, negotiate roles, and learn cooperation (Pyle & Danniels, 2017). These interactions help children cultivate empathy, teamwork, and conflict resolution, essential for both social and emotional growth (Gibson et al., 2023).

Fostering Creativity and Imagination

Play-based learning nurtures creativity and imagination, key aspects of experiential education (Craft, 2018). Activities such as storytelling, drawing, and pretend play allow children to explore new ideas and express themselves freely (Russ & Wallace, 2020). Encouraging creativity in early

education enhances problem-solving skills, adaptability, and innovative thinking, which are crucial for lifelong learning (Bolden et al., 2021).

Holistic Development

Experiential learning promotes a holistic approach to education, addressing children's physical, cognitive, social, and emotional needs (Taggart et al., 2023). Play-based learning supports diverse areas of development, such as motor skills through physical play, cognitive abilities through puzzles, and emotional regulation through social interactions (Whitebread et al., 2019). This comprehensive approach ensures well-rounded growth, preparing children for future learning experiences.

Experiential learning theory provides a strong foundation for play-based education in early childhood settings. By emphasizing real-world engagement, critical thinking, collaboration, and creativity, this approach fosters meaningful learning experiences. Play-based education not only enhances cognitive and social development but also nurtures a lifelong love of learning, aligning with the principles of active, experiential education (Pyle et al., 2021).

2.2 Concept of Play

The perspective of children`s play was initially considered in education as a yardstick for the development of pedagogy (Papatheodorou, & Potts, 2021). There has been lots of research and findings produced over the years relating to the definition of play. Several researchers and theorists define play differently, however, many different perspective views on what play is overlapped with other views. Play can be viewed, conceptualized, and defined from many different theoretical and ideological perspectives.

Boakye (2021) defined play as, “an activity that is symbolic, meaningful, active, pleasurable, voluntary, rule-governed and episodic”. Play as pleasurable and an activity, is seen as a situation by which children learn and interact with the environment and the world around them (Moyles, 2014). Gordon (2009) also argues that “play is the voluntary movement across boundaries, opening with total absorption into a highly flexible field, releasing tension in ways that are pleasurable, exposing players to the unexpected and making transformation possible.” (p. 8). Through play children learn informally and relate their play to real life experiences. The voluntary movement of children which includes exploration, playing and learning according to their interests, offer them the opportunity to satisfy their curiosity and level of maturation.

Additionally, Moyles, (2014) indicated that characteristics of play include intrinsic motivation, engagement; dependence on internal rather than external rules, control and autonomy, and attention to means rather than ends”. Children formulate their own rules to suit and match with the play situation. Therefore, children experience joy and skills development through self-motivation. According to Nilsson et al., (2018), play is considered a learning situation or an activity initiated by children, on the other hand, learning is regarded as a result of a practice or activity initiated by any adult to help children learn. They further state that play activities as well as learning situations are as joyful since both play and learning are seen as an activity that is transgression. Play and learning are interrelated; the two words touch on each other in an early childhood setting and further serves as an important process for promoting children’s learning and development (Bodrova, & Leong, 2024). Play provides children the opportunity to discover the world and find new answers through voluntary learning. Also, children`s play promotes and enhances socio-emotional development, cognitive and physical skills that cannot be taught through formal classroom instruction (Ministry of Education Science and Sports, 2007).

Play provides children with the opportunity to discover the world and find new answers through voluntary learning. Children are likely to be engaged in play activities that are relevant to them and can play and have an active participation. Additionally, play is pleasurable and can be defined as an activity requiring no end or goal only participation and fun (Besio, 2017).

One important aspect of children`s play to be considered is the use of play in early years setting. Combining play in the teaching process in the early years setting, there is the need for greater confidence among practitioners in approaching problems without fear and taking risks needed in the search for new ideas to help the development of children. Play is often being regarded as a cognitively challenging process, which requires the child to make use ability, memory, signs and symbols, and cultural tools which include the development of language, social skills such as negotiations, communication, planning and sharing, and prediction (Wolfberg, 2015). Many skills that are needed for later life are developed through play and also are very important in a preschool setting. Children will continue to make use of different learning situations, and experiences and in remembrance for further learning. In general, play is considered an important learning activity and developmentally appropriate which is considered valuable for all children (Irvin, 2017). Although play is very important for children and it`s usage in the school`s context or early year settings, (Hyvonen, 2011) expresses similar sentiment that it should be restricted by hindrances. The discourse of play both in theory and practice in early childhood education is very vital as stages of human evolution.

2.3 Benefits of play

Play has enormous benefits in the development of the child present in this section of the literature are the following benefits:

- Cognitive

- Physical development
- Intellectual development
- Social development/competence
- Emotional development
- Socio-linguistic development

Explaining play in terms of various types of play, as well as researching its role in cognitive, social, and socio-linguistic development, has been a focal point for developmental psychologists throughout the 20th century. By the end of the century, the importance of play for language and literacy learning (Roskos & Christie, 2013), emotional development (Pellegrini, 2013), social competence, and peer group affiliation was widely recognized. Research also showed its role in spatial and mathematical learning (Ramani & Siegler, 2011) and the development of positive learning dispositions (Whitebread & O'Sullivan, 2012).

Concept of play in terms of progressive levels of social participation emphasized the role of social interaction in play. However, more recent studies have critiqued this for implying that solitary play is less advanced, and for underestimating young children's capacity for social interaction. This has led to the erroneous view that infants and toddlers do not engage in 'proper' play (Gillespie & Hunter, 2018). More current understanding acknowledges that solitary play can still support important cognitive and social skills (Lillard et al., 2013).

Piaget's (1962) concept of play as progressing through stages defined by qualitatively different levels of thinking has been highly influential in early childhood education. His constructivist approach emphasized the interaction between a child's cognitive structures and the external world

(French, 2007). This view has been associated with a “laissez-faire” free-play curriculum, where children make their own choices, with minimal adult intervention. However, Vygotsky's sociocultural theory of development offered a different perspective, emphasizing the role of adults and peers in learning (Smidt, 2013).

Vygotsky argued that while play was not the only feature of childhood, it played a leading role in development (Bodrova & Leong, 2015). His focus on the cognitive and social functioning required in socio-dramatic play has had a profound influence on early childhood pedagogy. His concept of the Zone of Proximal Development (ZPD) challenged the “free-play” approach, suggesting that adults need to actively engage with children in play to stimulate learning. This interaction, however, should not be seen as formal instruction but as learning embedded in everyday activities and social interactions (Katajavuori et al., 2019). Vygotsky noted two critical features of pretend play: the creation of imaginary situations to explore desires and emotions, which promotes self-regulation, and the inherent rules for behavior within these scenarios (Berk, 2013).

The prevailing approach to play in early childhood education (ECE) throughout the 1970s, 1980s, and 1990s linked different types of play to developmental domains and viewed play as a sign of maturing within specific behaviors. The concept of "developmentally appropriate practice" (DAP), popularized by the National Association for the Education of Young Children (NAEYC) in the United States, emphasized play as a critical vehicle for children’s overall development. Play was understood as a key component for cognitive, social, emotional, physical, and moral development (Bredekamp & Copple, 2013).

Instead of linking play to specific domains of development, more recent frameworks, such as the National Council for Curriculum and Assessment’s (NCCA) *Framework for Early Learning*,

emphasize the interconnected nature of play in child development. Children develop through themes such as Well-being, Identity and Belonging, Communicating, Exploring and Thinking, reflecting how play engages multiple areas of development simultaneously (NCCA, 2015). In practice, children's play often spans multiple forms and developmental domains, with children showing preferences for certain types of play that reflect their personal, cognitive, and social development (Wood, 2014).

2.3 Empirical Review

2.4 Educators' Views of Play-Based Numeracy Instruction

The effectiveness of play-based numeracy instruction is largely dependent on educators' knowledge and pedagogical competencies. Early childhood educators play a critical role in shaping children's mathematical understanding, yet their ability to integrate play-based learning into numeracy instruction varies significantly (Pyle et al., 2021). While some educators have a strong theoretical foundation in play-based pedagogy, others lack the necessary training and practical experience to implement these strategies effectively (Goffin & Washington, 2019). This inconsistency in educators' knowledge often results in varying levels of play integration across early childhood education settings, which can impact children's mathematical development.

Studies suggest that although many early childhood educators acknowledge the benefits of play in facilitating mathematical learning, they struggle with balancing structured numeracy instruction with child-led play activities (Pakarinen et al., 2023). Some educators perceive play as an informal approach that lacks the rigor needed for numeracy instruction, while others recognize its potential but feel constrained by curriculum demands and assessment expectations (Weisberg et al., 2016).

This highlights the need for professional development programs that equip educators with strategies for integrating play into numeracy instruction effectively.

Play-based numeracy instruction has been widely recognized for its benefits in enhancing mathematical understanding among young learners. Engaging in playful activities allows children to construct knowledge through exploration, experimentation, and problem-solving, which fosters a deeper and more meaningful grasp of mathematical concepts (Clements & Sarama, 2018).

One of the primary advantages of play-based numeracy instruction is its role in developing conceptual understanding. Through hands-on experiences, children can manipulate objects, experiment with numbers, and identify patterns, which reinforces foundational numeracy skills (Verdine et al., 2017). For example, activities such as counting blocks, sorting shapes, and engaging in pretend shopping scenarios allow children to grasp numerical relationships in a context that is relevant to their everyday experiences. Such activities encourage exploration and facilitate the development of number sense, which is essential for later mathematical proficiency (Baroody et al., 2020).

In addition to conceptual understanding, play-based numeracy instruction enhances engagement and motivation. Young children are naturally curious, and learning through play nurtures their intrinsic motivation to explore mathematical ideas (Whitebread & Bingham, 2019). Unlike traditional rote memorization methods, play-based approaches transform numeracy learning into an enjoyable and interactive process. When children engage in playful problem-solving tasks, they are more likely to persist in their learning and develop a positive attitude toward mathematics (Hassinger-Das et al., 2021).

Furthermore, play-based numeracy instruction promotes both social and cognitive development. Collaborative play activities, such as board games and group problem-solving tasks, encourage communication, negotiation, and teamwork, all of which are essential for mathematical reasoning (Lippard et al., 2019). When children explain their thinking to peers, justify their reasoning, and listen to others' perspectives, they refine their understanding of mathematical concepts. This social interaction also helps develop executive functioning skills such as working memory, cognitive flexibility, and self-regulation, which are crucial for academic success (Ramani & Eason, 2015).

Despite the benefits, several challenges hinder the effective implementation of play-based numeracy instruction. A major challenge is the lack of sufficient teacher training in play-based pedagogy. Many early childhood educators receive limited professional development on integrating play into numeracy instruction, leading to uncertainty about how to align playful learning experiences with curriculum standards (Zosh et al., 2018). In some cases, educators may resort to direct instruction methods due to time constraints, pressure to meet learning outcomes, or limited confidence in facilitating play-based mathematical activities (Aunio et al., 2022).

Another significant challenge is the misconception that play is separate from academic learning. Some educators and policymakers view play as an unstructured activity that lacks educational value, leading to reduced emphasis on play-based approaches in early childhood curricula (Mardell et al., 2016). This belief can result in a preference for traditional teaching methods that prioritize worksheets and direct instruction over exploratory learning. However, research indicates that structured play, where educators scaffold children's learning while maintaining the playful nature of activities, is highly effective in promoting numeracy skills (Ginsburg et al., 2020).

Additionally, the availability of resources and classroom constraints can impact the implementation of play-based numeracy instruction. In under-resourced settings, teachers may lack access to materials such as manipulatives, math-focused play kits, or technology-enhanced learning tools that support playful numeracy activities (Howard et al., 2022). Large class sizes and rigid timetables can also limit the opportunities for child-initiated mathematical exploration, as teachers may struggle to provide individualized support in play-based environments (Pakarinen et al., 2023).

To improve the integration of play-based pedagogy in numeracy instruction, targeted professional development programs are essential. Training initiatives should focus on equipping educators with strategies for incorporating play into mathematical instruction while maintaining curricular alignment (Zosh et al., 2018). Workshops, coaching, and peer collaboration can help educators gain confidence in facilitating play-based numeracy activities and provide them with practical examples of effective implementation.

Another key strategy is to foster a mindset shift among educators regarding the value of play in numeracy learning. By highlighting research evidence that supports play-based mathematical instruction, professional development initiatives can challenge misconceptions that play is incompatible with structured learning (Weisberg et al., 2016). Encouraging educators to observe, document, and assess children's mathematical learning within play contexts can help them recognize the rich numeracy experiences embedded in everyday activities (Clements & Sarama, 2018).

Collaboration between educators, policymakers, and curriculum designers is also crucial in promoting play-based numeracy instruction. Policies should advocate for play as a fundamental

part of early childhood education and provide educators with the flexibility to incorporate playful learning experiences into their daily routines (Mardell et al., 2016). Schools can support educators by creating learning environments that facilitate hands-on mathematical exploration, such as well-equipped play corners, outdoor learning spaces, and inquiry-based math centers (Ginsburg et al., 2020).

Play-Based Activities Used in Teaching Numeracy in Kindergarten

Play-based pedagogy has gained widespread recognition as a critical approach in early childhood education, particularly in kindergarten settings. Contemporary research highlights that play-based strategies not only foster cognitive development but also enhance social, emotional, and physical growth, particularly in foundational numeracy skills (Pyle et al., 2021; Weisberg et al., 2022). Early childhood teachers employ various play-based strategies to create rich learning environments that facilitate young children's holistic development while ensuring meaningful numeracy learning experiences.

Play-based activities have gained widespread recognition as effective tools for developing numeracy skills in early childhood education. This instructional approach aligns with how young children naturally learn through exploration, manipulation, and social interaction (Fisher et al., 2017; Clements & Sarama, 2020). Contemporary research affirms that integrating mathematics into playful contexts not only enhances understanding but also nurtures positive attitudes toward learning (Becker & Park, 2022; Robinson et al., 2023). Several types of play-based activities have been identified as especially impactful in promoting numeracy development among kindergarten learners.

Counting games serve as a foundational component in play-based numeracy learning. These involve the use of familiar items such as bottle tops, beads, blocks, or sticks, allowing children to physically count, group, and compare quantities. According to Baroody (2019), manipulating real objects helps children move beyond rote counting toward a deeper conceptual understanding of quantity and number relationships. Clements and Sarama (2020) emphasize that such experiences promote one-to-one correspondence and cardinality critical early number concepts. When children count aloud while physically interacting with objects, they activate multiple sensory pathways, which enhances cognitive processing and memory retention (Hsin & Wu, 2021). For instance, learners who group bottle tops into sets of five not only practice counting but also begin to understand addition and multiplication as grouping operations.

Number recognition through play incorporates matching games, puzzles, flashcards, and sequencing tasks that help children identify numerals and associate them with corresponding quantities. This form of symbolic recognition is crucial for early mathematical literacy and later arithmetic learning (Walsh et al., 2020). Activities such as matching numeral cards with sets of objects or arranging numbers in ascending or descending order support children in understanding number order and quantity. According to Ginsburg et al. (2021), young children benefit most from learning environments where numerals are introduced in playful, hands-on contexts rather than isolated drill exercises. Furthermore, such visual and tactile experiences are especially effective for learners who might struggle with abstract instruction alone.

Mathematical storytelling offers a highly engaging approach by embedding mathematical concepts within relatable narratives. In this activity, children are prompted to act out or solve number-related scenarios using toys or manipulatives. For example, a story about shopping at a market might

involve “buying” and “selling” fruit using counting and subtraction. This not only introduces arithmetic in context but also supports children’s language development and listening skills (Jackson & Hunt, 2022). Sarama and Clements (2022) argue that storytelling enhances comprehension by providing meaningful context to mathematical problems, allowing children to see the relevance of math in everyday life. Berkowitz et al. (2022) further assert that narrative-based math activities can significantly reduce math anxiety by presenting problem-solving as part of an imaginative and emotionally safe experience.

Pattern recognition activities involve the use of colored beads, tiles, or shape cutouts to identify, create, and extend patterns. These tasks help children develop logical reasoning and early algebraic thinking by identifying regularities and predicting sequences (Sarama & Clements, 2022). According to Becker and Park (2022), patterning is one of the best predictors of future success in mathematics, as it underlies more advanced concepts such as number sequences, skip counting, and functions. Engaging in pattern-based games also fosters cognitive flexibility, attention to detail, and visual-spatial reasoning skills that are foundational for both numeracy and general problem-solving.

Measurement play introduces children to the concept of size, length, weight, and volume using non-standard units such as blocks, strings, or even hands and feet. For instance, children might measure the length of a mat using bottle caps or compare the weight of two objects by holding them. These informal tasks provide a conceptual understanding of measurement long before formal units like centimeters or kilograms are introduced (Sullivan & Bers, 2021). According to Whitebread et al. (2020), children develop deeper understandings of magnitude and comparison when they physically explore measurement rather than only observing or discussing it. Play-based

measurement also enhances estimation skills, a core numeracy competency identified in the Early Years Mathematics Framework (NAEYC, 2023).

Shape and spatial awareness games use construction sets, puzzles, drawing tasks, and digital applications to develop understanding of geometry and spatial reasoning. Children might be asked to identify shapes within their environment, construct structures using blocks, or navigate objects through mazes. According to Gopnik (2021), spatial awareness is an essential mathematical skill that supports geometry learning and problem-solving. These activities encourage children to use spatial vocabulary such as "behind," "above," or "next to" while building an understanding of the properties of shapes and their relationships (Robinson et al., 2023). The physical manipulation of shapes not only aids in recognition but also in internalizing characteristics like symmetry, corners, and sides, which are often abstract in traditional instruction.

These varied types of play-based numeracy activities counting games, number recognition, mathematical storytelling, patterning, measurement, and spatial games collectively support a comprehensive, developmentally appropriate approach to math instruction in early childhood. They promote engagement, cater to diverse learning styles, and provide opportunities for children to develop cognitive, motor, and social-emotional skills simultaneously (Fisher et al., 2017; Baroody, 2019; Becker & Park, 2022). Importantly, these activities create a positive learning environment where children feel confident, motivated, and free to make mistakes conditions essential for fostering a growth mindset in mathematics (Berkowitz et al., 2022).

By integrating math into everyday play, educators help children see mathematics not as a separate, abstract subject but as a meaningful part of the world around them. As Clements and Sarama (2020) argue, early math learning should be "embedded in meaningful activities and contexts," not

isolated from children's natural curiosity and interaction. In this way, play-based pedagogy transforms early numeracy instruction into a rich, enjoyable, and effective experience.

Free play is one of the most common strategies used in early childhood education. It allows children to choose their activities and explore materials independently, fostering creativity, problem-solving, and decision-making skills (Zosh et al., 2018). In numeracy instruction, teachers incorporate manipulatives such as counting blocks, shape puzzles, and measuring tools to encourage informal mathematical exploration. For example, a child building a tower with blocks engages in spatial reasoning, measurement, and number comparison without direct teacher intervention (Gifford, 2020). Although free play is unstructured, teachers play a crucial role in observing and facilitating learning, stepping in to pose questions or extend play when necessary to encourage deeper mathematical thinking (Jay & Knaus, 2018).

Guided play balances child-led exploration with teacher-directed learning and is particularly effective in numeracy instruction (Fisher et al., 2020). In guided play, teachers design activities with specific learning objectives while allowing children the freedom to explore and manipulate materials within a structured environment. For example, a grocery store role-play scenario enables children to engage in counting, addition, and money recognition as they use play money to purchase items. Research suggests that guided play enhances children's numerical understanding more effectively than direct instruction while maintaining the engagement and motivation inherent in play (Gibbs et al., 2021).

A study by Pyle and DeLuca (2017) found that guided play activities such as dice games, sorting exercises, and storytelling with numerical elements significantly improve children's ability to recognize patterns, classify objects, and develop number sense. Teachers can further scaffold

learning by introducing prompts like "How many apples do you need?" or "What happens if you buy two more?" to encourage mathematical reasoning.

Dramatic play is another essential strategy used in kindergarten classrooms to support numeracy learning. This type of play allows children to assume various roles, such as shopkeepers, chefs, or bankers, and act out scenarios that incorporate real-world mathematical concepts (Singer & Lillard, 2021). In a restaurant play setting, for instance, children engage in activities such as taking orders, calculating totals, and making change, all of which involve number operations and problem-solving (Seo & Ginsburg, 2020).

Teachers enhance dramatic play by providing structured prompts, such as "Can you divide the pizza into four equal slices?" or "How much does this meal cost?" to incorporate fractions, addition, and subtraction naturally into the play experience (Zacharos et al., 2019). Research highlights that dramatic play significantly enhances early numeracy by linking abstract mathematical concepts to familiar, meaningful contexts (Wolf et al., 2022).

Outdoor play also plays a crucial role in play-based numeracy instruction. Engaging in activities such as hopscotch, scavenger hunts, and measuring natural objects supports mathematical thinking in a dynamic and engaging environment (Waite et al., 2020). Outdoor play provides opportunities for children to practice number recognition, counting, patterns, and measurement through movement-based activities (Bento & Dias, 2017).

For instance, teachers can organize nature-based mathematical scavenger hunts where children count leaves, compare stick lengths, or identify geometric shapes in their surroundings (Ridgers et al., 2018). Studies show that integrating numeracy into outdoor play fosters children's problem-

solving abilities and enhances their understanding of mathematical concepts through experiential learning (Little & Wyver, 2021). Additionally, regular engagement with outdoor numeracy activities strengthens children's spatial awareness and estimation skills, which are critical for later mathematical proficiency (Lange et al., 2022).

Play-based strategies provide a rich and engaging framework for teaching numeracy in kindergarten classrooms. Free play nurtures early mathematical exploration, guided play ensures structured yet flexible numeracy learning, dramatic play contextualizes mathematics in real-world scenarios, and outdoor play enhances experiential mathematical understanding. Research underscores that when teachers integrate numeracy into play-based learning, children develop foundational math skills in a meaningful, enjoyable, and developmentally appropriate manner (Zosh et al., 2018; Fisher et al., 2020). Strengthening teacher training in play-based numeracy approaches can further enhance their ability to create engaging and effective mathematical learning experiences for young children.

Music and movement are essential play-based strategies that support numeracy development through rhythm, patterns, and sequencing. According to Hallam (2010), rhythmic activities stimulate cognitive processes associated with early mathematical reasoning. Teachers can incorporate counting songs, clapping patterns, or dance routines that require children to count beats or steps, reinforcing their understanding of number sequences and one-to-one correspondence. Zachopoulou et al. (2015) suggest that integrating movement with mathematical concepts, such as hopscotch with numbered squares, enhances children's ability to grasp numerical order and develop gross motor coordination. This active learning approach engages children physically and cognitively, making numeracy instruction more dynamic and effective.

Effectiveness of Play-Based Pedagogy in Numeracy Skills Development

Play-based pedagogy has emerged as a significant instructional approach in early childhood education, particularly concerning developing numeracy skills among kindergarten learners. Numeracy skills, including counting, number recognition, and basic arithmetic, are foundational for children's academic trajectories (Baroody, 2019). Early proficiency in these areas is linked to improved mathematical performance in subsequent educational stages (Jordan et al., 2021). Traditional instructional methods often rely on direct teaching, where educators present information passively and students receive it (Clements & Sarama, 2020). However, this approach may not fully engage young learners or address their developmental needs (Fisher et al., 2017). Grounded in constructivist theories of learning, particularly those of Piaget and Vygotsky, play is recognized as a natural and essential way through which young children explore, understand, and internalize new concepts. When applied to numeracy instruction, play-based approaches offer rich opportunities for active, meaningful, and enjoyable learning.

2.5 Concrete Learning Through Hands-On Activities

Young children learn best through doing. In play-based numeracy instruction, concrete manipulatives such as bottle tops, counting stones, building blocks, and puzzles help children develop foundational mathematical concepts. These hands-on materials make abstract ideas like counting, addition, subtraction, measurement, and shape recognition accessible and meaningful (Walsh et al., 2020). Manipulating physical objects enables learners to visualize quantities and perform operations through direct engagement with the environment.

For instance, a child grouping bottle tops into sets of five and counting them learns not just the sequence of numbers but also the concept of quantity. Similarly, children using blocks to compare

lengths or weights begin to grasp the basic principles of measurement and comparison. According to Ginsburg et al. (2021), young learners require tangible experiences to build their "number sense" an intuitive understanding of numbers, their magnitude, relationships, and how they are affected by operations. These physical experiences lay the foundation for later symbolic understanding.

The efficacy of hands-on, concrete learning is also supported by neuroscience. Research shows that sensorimotor experiences where touch and movement are involved activate more brain areas than passive listening or visual observation alone, thereby enhancing memory retention and concept internalization (Hsin & Wu, 2021). Consequently, play-based numeracy instruction using real-world materials not only engages the senses but also strengthens cognitive development.

Increased Engagement and Motivation

Engagement is a key predictor of learning outcomes, and play naturally captures children's interest. In contrast to traditional methods that may rely heavily on rote memorization or paper-based drills, play-based numeracy is inherently enjoyable. Activities such as dice games, number scavenger hunts, "count and clap" exercises, or story-based math challenges infuse fun into learning while reinforcing key mathematical concepts.

Children are more likely to sustain attention and participate actively in activities they enjoy (Becker & Park, 2022). In turn, this active engagement improves not only task persistence but also deeper understanding and longer retention. Motivation increases when learning feels like play rather than a chore.

Moreover, play introduces a sense of purpose and agency into learning. When children roll a dice to move forward on a game board or match number cards to physical objects, they are not just memorizing they are making choices and seeing the outcomes of their decisions. This interactive

and responsive nature of play keeps learners engaged while supporting the development of self-regulation and executive function (Whitebread et al., 2020).

Supports Diverse Learning Styles

Every child is unique in how they learn best. Play-based pedagogy is inclusive in that it accommodates various learning preferences visual, auditory, tactile, and kinesthetic. Through diverse activities such as singing number songs, using counting mats, constructing shapes, or moving in response to number cues, children can access content in the modality that resonates most with them. For example, a visual learner might benefit from shape-matching puzzles or color-coded number lines, while an auditory learner thrives through number songs and rhythmic counting. Kinesthetic learners, who learn by moving and doing, are particularly supported by active games like hopscotch number trails or measuring objects using footsteps (Sullivan & Bers, 2021).

In classrooms where instructional approaches cater to multiple learning styles, students demonstrate improved comprehension, engagement, and enthusiasm. As Knaus (2023) notes, the adaptability of play-based instruction makes it particularly effective in heterogeneous classrooms, where learners vary widely in developmental level, background knowledge, and cognitive style.

Encourages Critical Thinking and Problem-Solving

Far from being mere entertainment, play offers complex problem-solving opportunities that foster critical thinking. When children engage in activities such as sorting objects, identifying patterns, comparing quantities, or figuring out how to reach a goal in a math game, they are practicing analytical skills fundamental to mathematics.

During these activities, children ask questions, make predictions, test ideas, and evaluate outcomes. For instance, when playing with pattern blocks, a child may try different arrangements to complete a sequence, correct errors, or explain their reasoning. These are the very foundations of mathematical thinking (Sarama & Clements, 2022). The low-stakes environment of play also encourages risk-taking and persistence, key attributes in developing resilience and problem-solving skills.

Vygotsky's sociocultural theory underscores the value of such interactions, particularly when scaffolded by more knowledgeable peers or adults. Through guided play, teachers can extend children's thinking by prompting reflection and introducing new vocabulary and concepts (Gopnik, 2021). This social construction of knowledge through play fosters both independent and collaborative problem-solving.

Developmentally Appropriate Practice

At the kindergarten level, learners are still developing core physical, emotional, and cognitive skills. Sitting for long periods or engaging in abstract reasoning may be developmentally inappropriate and counterproductive. Play, on the other hand, aligns with young children's developmental needs and learning style. It integrates movement, imagination, social interaction, and discovery all essential components of early learning.

Play-based numeracy activities like acting out number stories, building towers to explore height, or comparing groups of toy animals enable children to learn while doing what comes naturally to them. According to the National Association for the Education of Young Children (NAEYC, 2023), effective early math instruction must be active, exploratory, and integrated with real-world experiences.

Furthermore, play-based learning promotes holistic development. It builds not just mathematical competence but also language skills, fine motor coordination, cooperation, and emotional self-regulation (Robinson et al., 2023). This integrated approach is particularly beneficial in early childhood, where learning domains are deeply interconnected.

Builds Confidence and Reduces Math Anxiety

A crucial yet often overlooked benefit of play-based numeracy is its capacity to build confidence and reduce anxiety. Mathematics, even in the early years, can become a source of stress when taught through rigid, performance-oriented approaches. Children may fear making mistakes or become discouraged if they struggle with traditional methods.

Play changes the emotional tone of learning. In play-based environments, mistakes are not failures but part of exploration. This fosters a growth mindset, where children are more willing to try, fail, and try again. Teachers have observed that once reluctant learners become enthusiastic participants when math is embedded in play activities (Jackson & Hunt, 2022).

Research supports these observations. A study by Berkowitz et al. (2022) found that early numeracy activities involving play significantly reduced anxiety levels in young learners and increased their willingness to engage in math tasks. Positive early experiences with math lay a strong emotional foundation for later academic success and influence children's attitudes toward the subject throughout their schooling.

Play-based pedagogy offers a powerful, developmentally appropriate approach to numeracy instruction in early childhood education. Through concrete hands-on activities, it allows children to build foundational mathematical understanding in ways that are tangible, meaningful, and enjoyable. The engaging nature of play boosts motivation, supports different learning styles, and

fosters critical thinking. It matches children's cognitive and emotional development, reduces anxiety, and builds confidence all of which are essential for long-term success in mathematics.

As education systems strive to improve early numeracy outcomes, especially in resource-constrained contexts, play-based strategies offer an equitable and effective solution. For policymakers, teacher training institutions, and practitioners, investing in quality play materials, teacher capacity building, and curriculum design that values play is crucial. By embracing the natural curiosity, energy, and creativity of young children, play-based numeracy instruction not only prepares learners for academic achievement but nurtures joyful, resilient, and capable thinkers.

2.7 Challenges teachers encounter in the use of play-based pedagogy

Play-based pedagogy has become a cornerstone of early childhood education, recognized for its ability to foster cognitive, social, emotional, and physical development in young children. Despite its numerous benefits, the implementation of play-based pedagogy presents several challenges for educators, particularly in kindergarten settings. These challenges can hinder the effectiveness of this approach and create barriers to its successful integration into early childhood curricula.

The GPE (2012) states that the main obstacles to ECEC programmes are low social demand for high-quality ECCE services, insufficient finance, ineffective and well-targeted interventions, and limited local and national administrative ability. Some of the issues plaguing Sub-Saharan Africa's preschool education are inadequate ECCE services, poor or nonexistent infrastructure, inadequate teaching and learning materials, curricula that are not well suited to the requirements of the kids, and a shortage of qualified teachers.

One of the most significant challenges teachers face in implementing play-based pedagogy is the pressure to meet curriculum standards and academic benchmarks. Many educators feel constrained by a packed curriculum that leaves little room for extended periods of play-based learning (Howard, 2010). The increasing emphasis on academic readiness and standardized testing has shifted the focus away from play, leading to a reduction in the time allocated for play-based activities in the classroom. Teachers often struggle to balance the need for academic instruction with the developmental benefits of play, resulting in a tension between fulfilling curriculum requirements and providing opportunities for meaningful play (Pyle & Danniels, 2017).

This focus on academic readiness has led to a shift towards more structured, teacher-directed activities that prioritize measurable outcomes over exploratory and imaginative play (Miller & Almon, 2009). As a result, the time available for play-based learning is often limited to short, scheduled periods that may not be sufficient to support the full range of cognitive, social, and emotional benefits associated with this pedagogical approach (Moyles, 2015).

Moreover, the rigid structure of the school day, with its tight schedules and frequent transitions between activities, further limits opportunities for uninterrupted play (Howard & McInnes, 2013). Teachers must often make difficult choices about how to allocate time, balancing the need for academic instruction with the developmental benefits of play. This tension between curriculum demands and the principles of play-based pedagogy can undermine the effectiveness of play-based approaches in fostering holistic child development (Wood, 2014).

Time Constraints

Time constraints pose significant challenges to the effective implementation of play-based pedagogy in early childhood education. Play-based learning requires sufficient time for children

to engage in exploration, creativity, and social interaction, all of which are critical for holistic development. However, many early childhood centres face pressure to meet academic standards and curriculum goals within limited timeframes, often prioritizing formal instruction over play (Jay & Knaus, 2018).

One major issue is the scheduling of structured learning activities that leaves little time for extended play. As teachers focus on covering the curriculum, the time allocated for child-led play is often reduced (Pyle & Danniels, 2017). Play-based pedagogy thrives on unhurried, uninterrupted periods where children can explore their interests and develop skills through sustained engagement. When play is rushed or truncated, the developmental benefits, such as problem-solving, collaboration, and emotional regulation, are diminished.

Additionally, time constraints often lead to a more teacher-directed approach to play, limiting children's autonomy and creativity. According to Howard and McInnes (2019), children benefit most from self-directed play, where they can take the lead and interact with their peers. However, limited time often forces educators to intervene more, directing play in ways that align with predetermined learning outcomes, which can reduce the spontaneity and exploration essential to play-based learning.

Inadequate Resources and Materials

Another common challenge is the lack of adequate resources and materials needed to effectively implement play-based pedagogy. High-quality play materials, such as blocks, art supplies, and educational toys, are essential for fostering creativity and exploration in young children (Wood, 2014). However, many educational settings, particularly in under-resourced schools, struggle to provide these necessary materials. Financial constraints often lead to limited access to diverse and

stimulating play materials, which can hinder the ability of teachers to create rich, engaging learning environments (Moyles, 2015). Without adequate resources, teachers may be forced to rely on more traditional, didactic teaching methods that do not fully engage children in the exploratory and imaginative activities central to play-based pedagogy (Pyle & Danniels, 2017).

Furthermore, the lack of appropriate resources can also impact the inclusivity and adaptability of play-based activities. For instance, children with different learning needs or disabilities may require specialized materials to fully participate in play-based learning (Manning, Garvis, Fleming, & Wong, 2017). The absence of such resources can limit the effectiveness of play-based pedagogy in supporting all children's developmental needs.

Classroom Management Difficulties

Classroom management during play-based activities is another significant challenge for teachers. Play-based pedagogy often involves unstructured or semi-structured activities that require teachers to manage a dynamic and sometimes chaotic classroom environment (Howard & McInnes, 2013). Unlike traditional, teacher-directed instruction, where students are expected to sit quietly and follow directions, play-based learning encourages movement, exploration, and interaction, which can lead to noise and disorder. Teachers must find a balance between allowing children the freedom to explore and ensuring that the classroom remains a conducive learning environment. Managing this balance can be particularly difficult in classrooms with large student-teacher ratios, where it is challenging to provide individualized attention to each child (Manning, Garvis, Fleming, & Wong, 2017).

Assessing children's learning outcomes through play-based pedagogy presents another challenge for teachers. Traditional assessment methods, such as tests and quizzes, are not well-suited to

measuring the learning that occurs during play (Broadhead, 2006). Play-based learning often leads to the development of skills and knowledge that are difficult to quantify, such as creativity, problem-solving, and social interaction. Teachers must rely on observational assessments, which can be time-consuming and subjective, making it challenging to document and demonstrate student progress effectively (Wood & Bennett, 2000). Additionally, the lack of standardized assessment tools for play-based learning can make it difficult for teachers to align their assessments with curriculum standards and expectations (Howard, 2010).

Parental and Administrative Expectations

The expectations of parents and school administrators can also pose challenges to the implementation of play-based pedagogy. Some parents may not fully understand or appreciate the value of play in early childhood education, leading them to prioritize more traditional, academically focused teaching methods (Pyle & Danniels, 2017). This lack of support from parents can create pressure on teachers to reduce the amount of time spent on play-based activities in favor of more direct instruction. Similarly, school administrators who are focused on meeting academic benchmarks and improving standardized test scores may be less supportive of play-based approaches, further complicating teachers' efforts to implement this pedagogy effectively (Miller & Almon, 2009).

Professional Development and Training Needs

A final challenge is the need for ongoing professional development and training in play-based pedagogy. Many teachers report feeling inadequately prepared to implement play-based strategies effectively, particularly if they have been trained in more traditional, teacher-directed methods (Moyles, 2015). Professional development opportunities that focus on the principles of play-based

learning, classroom management techniques, and assessment strategies are essential for helping teachers build the skills and confidence needed to incorporate play into their teaching practices. However, access to high-quality professional development can be limited, particularly in under-resourced schools or regions (Manning et al., 2017).

Lack of space in the classroom and outdoor environment

The lack of adequate space in classrooms and outdoor school environments significantly hampers the effective implementation of play-based pedagogy in kindergarten centers. Play-based learning requires ample physical space to accommodate various activities that support children's cognitive, social, emotional, and physical development. However, overcrowded classrooms and limited outdoor areas can severely restrict the range of play activities that can be offered, ultimately affecting the quality of early childhood education.

In many kindergarten classrooms, especially in densely populated or under-resourced areas, space is often a major limitation. Overcrowded classrooms, where children have limited room to move freely, can impede the implementation of essential play-based activities such as dramatic play, block building, and sensory play (Manning, Garvis, Fleming, & Wong, 2017). These activities require sufficient space for children to explore, manipulate materials, and engage in cooperative play. When space is limited, teachers may be forced to minimize or eliminate play-based activities, resorting to more sedentary and teacher-directed methods of instruction, which do not fully engage young learners in active exploration and creativity (Pyle & Danniels, 2017).

Furthermore, the lack of designated areas within the classroom for different types of play, such as art corners, reading nooks, and construction zones, can reduce the effectiveness of play-based pedagogy. These spaces are crucial for encouraging children to engage in various forms of play,

each supporting different aspects of their development (Wood, 2014). Without such dedicated spaces, the opportunities for children to engage in diverse and meaningful play experiences are significantly diminished.

Similarly, outdoor play is a critical component of play-based pedagogy, offering children opportunities for physical activity, risk-taking, and social interaction in a less structured environment (Ginsburg, 2007). However, the lack of sufficient outdoor space in many kindergarten centers can severely restrict the types of play activities that can be conducted. Limited playground areas, lack of greenery, and inadequate play equipment can hinder children's ability to engage in outdoor exploration, gross motor activities, and nature-based learning experiences (Fjørtoft, 2004).

Moreover, when outdoor spaces are small or poorly designed, they may not provide the necessary variety of play experiences, such as climbing, running, and imaginative play, which are essential for children's physical and social development (Moyles, 2015). The absence of natural elements like trees, sand, and water further restricts opportunities for sensory play and environmental exploration, which are key aspects of play-based pedagogy.

The constraints imposed by inadequate space can also place additional stress on educators, who must navigate these limitations while trying to implement an effective play-based curriculum. Teachers may find it challenging to organize and manage play activities in cramped environments, leading to frustration and a potential decrease in the quality of interactions between teachers and learners (Howard & McInnes, 2013). Additionally, the lack of space may result in more frequent conflicts among children as they compete for limited play areas, which can negatively impact the social and emotional climate of the classroom (Pyle & Danniels, 2017).

Even the most playfully inclined children will not be able to play, sufficiently for them to reap the benefits in terms of their learning and development if they are not given the time, the space, and the independence to develop their own spontaneous and self-initiated play activities. Lester and Russell (2010) provide a very useful review of the now quite extensive literature studying children's use of urban and rural spaces for playful purposes. What emerges from this is that, in their play, children's appropriate different spaces and features within their environment which are quite unpredictable by adults, and that the richest play spaces are mostly natural and unplanned. Many urban playgrounds, designed by adults, are often too neat and tidy, and essentially often rather barren as regards playful opportunities. The most successful urban play environments are 'adventure playgrounds' which are set up so that children can adapt them and build their own spaces, using a range of natural and man-made building materials (Bartlett, 2002).

Play-based pedagogy offers significant benefits for early childhood education, but its implementation is not without challenges. Teachers face a range of obstacles, including time constraints, inadequate resources, classroom management difficulties, assessment challenges, and a lack of support from parents and administrators. Additionally, the need for ongoing professional development is critical to ensuring that teachers have the skills and knowledge necessary to implement play-based learning effectively. Addressing these challenges requires a concerted effort from educators, administrators, and policymakers to create supportive environments that prioritize the developmental needs of young children through play.

2.8 Chapter Summary

Chapter Two provides a comprehensive overview of the existing literature on the implementation of play-based pedagogy in numeracy instructions. The chapter begins with the theoretical framework which highlights the sociocultural theory by Lev Vygotsky and the Experiential

Learning Theory by John Dewey as well as their implications on the study. The chapter further captured the concept of play, play in early childhood education, the benefits of play in early childhood education and the conceptual framework of the study. The chapter further highlights the key elements that contribute to the objectives of the study. It reviewed literature on early childhood teachers' knowledge of the use of play-based pedagogy in numeracy instructions, types of play-based activities used in numeracy instructions, the effectiveness of the use of play-based in numeracy instructions, and the challenges early childhood educators encounter in the implementation of play-based pedagogy in numeracy instructions.

CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter presents a description of the methods employed to explore the implementation of play-based pedagogy in numeracy instruction within early childhood centres in the Nsuaem Circuit. The chapter is organized under the following subheadings: research paradigm, research approach, research design, population, sample and sampling procedures, data collection instruments, trustworthiness criteria, data collection procedures, data analysis, and ethical considerations.

3.1 Research Paradigm

The interpretivist paradigm was deemed most appropriate for this study as it emphasizes understanding the subjective experiences and meanings constructed by individuals within their natural settings (Creswell & Poth, 2018). This study seeks to examine how early childhood educators perceive, interpret, and implement play-based pedagogy in teaching numeracy, making the interpretivist paradigm an ideal fit.

The interpretivist perspective is concerned with uncovering the beliefs, attitudes, and practices of individuals within their unique social and cultural contexts (Bryman, 2016). In this study, teachers' experiences and applications of play-based pedagogy are influenced by their professional backgrounds, cultural values, and available resources. Adopting this paradigm enables the researcher to explore these personal and contextual factors, providing rich, qualitative insights into how numeracy instruction is shaped through play-based methods.

The Nsuaem Circuit presents a distinctive educational environment characterized by specific challenges, cultural influences, and resource limitations that affect pedagogical practices.

Interpretivism prioritizes understanding phenomena within their natural context (Guba & Lincoln, 1994). By applying this paradigm, the study aims to capture the nuances of how play-based numeracy instruction is implemented and adapted within the unique realities of early childhood classrooms in the circuit.

Moreover, the interpretivist paradigm aligns well with qualitative research methods such as interviews, observations, and focus group discussions (Merriam & Tisdell, 2016). These methods facilitate the collection of in-depth, contextual data regarding teachers' instructional strategies, experiences, and challenges in using play-based pedagogy for numeracy.

Since play-based pedagogy involves interactive and learner-centered teaching approaches that require flexibility and creativity from teachers, an interpretivist approach which emphasizes meaning-making and personal interpretation is particularly suitable for examining how educators develop, interpret, and adjust these strategies in numeracy instruction (Scotland, 2012).

In conclusion, the interpretivist paradigm offers a solid theoretical foundation for investigating the lived experiences, contextual realities, and instructional choices of early childhood educators in the Nsuaem Circuit. It enables the researcher to comprehensively understand how play-based pedagogy is implemented in numeracy lessons, considering both personal and contextual influences.

3.2 Research Approach

This study adopted a qualitative research approach. The qualitative approach was selected because it allows for an in-depth investigation of teachers' experiences, instructional practices, and viewpoints. It emphasizes understanding events and practices within their real-life settings, making it particularly suitable for examining how play-based pedagogy is implemented in numeracy instruction in early childhood classrooms in the Nsuaem Circuit (Creswell & Poth, 2018).

This approach aligns with the study's objective of exploring the varied ways teachers employ play-based strategies to support the development of numeracy skills among young learners. Qualitative research, through techniques such as interviews, classroom observations, and focus group discussions, enables the collection of rich, descriptive data that captures the complexities of teaching practices and the meanings teachers attach to the use of play-based methods (Merriam & Tisdell, 2016). These methods also provide participants the opportunity to share their perspectives freely, offering deeper insight into the contextual factors shaping their instructional decisions.

Additionally, qualitative research is highly valuable in educational studies, where the focus extends beyond quantifiable outcomes to processes, interactions, and lived experiences (Denzin & Lincoln, 2017). In this study, it provides a means of examining how cultural, social, and institutional factors within the Nsuaem Circuit influence the adoption and practice of play-based pedagogy in numeracy teaching.

While the qualitative approach offers considerable strengths, it also comes with limitations. It can be time-consuming and demands considerable effort in both data collection and analysis (Miles et al., 2020). Moreover, the subjective nature of qualitative interpretation may introduce researcher bias, which could impact the trustworthiness of findings (Flick, 2018). The flexible nature of qualitative data collection may also make it difficult to generalize findings beyond the specific context studied.

Nevertheless, these limitations can be addressed through strategies such as triangulation, reflexivity, and careful documentation of the research process. Given its strengths in providing rich, contextualized insights into teachers' experiences and practices, the qualitative approach remains the most appropriate for this study.

3.3 Research Design

The study employed an exploratory case study design to investigate the implementation of play-based pedagogy in numeracy instructions within early childhood centres in the Nsuaem Circuit. The exploratory case study design offers a structured framework for examining relatively under-researched phenomena within their natural contexts (Yin, 2018). This design is appropriate for generating insights into how play-based pedagogy is practiced in numeracy teaching, in line with the study's aim of uncovering teachers' instructional approaches, challenges, and the contextual influences that shape their use of play-based strategies.

An exploratory case study is particularly suitable for research that seeks to answer "how" and "why" questions (Yin, 2018). In this case, it facilitates a detailed investigation into how teachers apply play-based activities in numeracy instruction, identifying the specific methods, tools, and classroom interactions involved. It also allows the study to explore why these approaches succeed or face obstacles, considering factors such as resource availability, teachers' professional preparation, and community attitudes toward play in education (Stake, 1995).

The Nsuaem Circuit provides a meaningful context for this study, blending conventional teaching methods with emerging child-centered pedagogies like play-based learning. The exploratory case study approach makes it possible to explore this environment in-depth, capturing the distinctive practices, experiences, and local realities that influence the implementation of play-based numeracy instruction. By focusing on selected schools and classrooms, the study generates context-rich insights that are valuable for informing both local educational strategies and contributing to broader academic discourse.

Furthermore, this research design accommodates the use of multiple data collection methods, including interviews, classroom observations, and document analysis, which are essential for

triangulating data and enhancing the credibility of the study's findings (Creswell & Poth, 2018). These methods help to capture the authentic experiences of teachers and the practical challenges faced within early childhood classrooms, aspects that quantitative methods might overlook.

While exploratory case studies present limitations, such as difficulties in generalizing findings and the intensive nature of data collection and analysis (Merriam & Tisdell, 2016), these are outweighed by the depth of understanding and context-specific insights they provide. As such, this design was considered most suitable for investigating the implementation of play-based pedagogy in numeracy instruction in early childhood education settings within the Nsuaem Circuit.

3.4 Population

The population of a study refers to the complete group of individuals, objects, or cases that meet specific criteria for inclusion (Burns & Grove, 2003). Similarly, Polit and Hungler (2004) describe a population as the totality of elements that share a set of defining characteristics. For this study, the target population consisted of all early childhood teachers within the Nsuem Circuit. This group was considered appropriate because these educators are actively involved in implementing play-based approaches in their classrooms and can offer valuable perspectives on their experiences, challenges, and practices. According to the Tarkwa Nsuem Municipal Education Directorate Report (2024), there are seventy-eight (78) kindergarten teachers working across twenty-two (22) early childhood centres in the Circuit.

3.5 Sample and Sampling Techniques

The effectiveness of any research is closely linked to the appropriateness of its sampling strategy, in addition to its methodology and data collection tools (Cohen, Manion, & Morrison, 2007). This study employed purposive sampling to select a group of 14 early childhood teachers. The selection was based on two key criteria: teachers who have received formal training in play-based pedagogy

and have accumulated at least ten years of teaching experience. This sampling method was intentionally chosen because it aligns with the study's goal of exploring the use of play-based strategies in numeracy instruction among experienced and well-trained practitioners (Etikan et al., 2016).

By focusing on teachers who meet these criteria, the study ensures that participants possess rich, relevant insights into both the benefits and challenges associated with implementing play-based methods. These seasoned educators are well-positioned to reflect on long-term practices and trends in early childhood numeracy instruction (Palinkas et al., 2015). The purposive sampling approach also supports the exploratory nature of the study, which prioritizes depth and context over broad generalization (Creswell & Poth, 2018). Although this method limits the generalizability of the findings, its strength lies in yielding detailed, context-specific data from information-rich cases.

3.6 Data Collection Instruments

To gather comprehensive qualitative data for this study, two primary instruments were employed: a semi-structured interview guide and an observational checklist. These tools were selected to provide a balanced and in-depth understanding of how early childhood teachers integrate play-based pedagogy into their numeracy instruction.

The semi-structured interview guide served as a flexible yet structured tool for eliciting detailed information from participants. It combined predetermined questions with open-ended prompts, allowing teachers to share their personal experiences and views while giving the researcher the flexibility to explore emerging topics of interest during the conversation (Kallio et al., 2016). This approach made it possible to examine teachers' instructional practices, beliefs, and the contextual factors that influence their use of play-based pedagogy in numeracy lessons (Creswell & Poth, 2018).

Complementing the interviews, an observational checklist was used to systematically record classroom activities and interactions during numeracy instruction. This tool enabled the researcher to capture firsthand evidence of how teachers implement play-based activities, the types of materials utilized, and the levels of learner engagement observed (Angrosino, 2016). The checklist format ensured consistency in data collection by focusing on specific indicators such as activity types, teacher-learner interactions, and use of play materials to support numeracy skills development.

The combination of interviews and classroom observations allowed for data triangulation, thereby enhancing the study's credibility and depth. While interviews provided insights into teachers' personal accounts, observations validated these claims by documenting actual classroom practices. This methodological blend offered a holistic view of the use of play-based pedagogy in early childhood numeracy instruction (Patton, 2015).

3.7 Trustworthiness Criteria

Trustworthiness criteria were established to ensure the rigor of the semi-structured interview guide. A key aim of the research was to translate the generated knowledge into actionable insights. Therefore, it was essential for researchers, practitioners, policymakers, and the general public to perceive the findings as credible and reliable. Employing trustworthiness criteria helps researchers assure themselves and their audience that the study's outcomes are valid and meaningful (Nowell, Norris, White, & Moules, 2017). The criteria applied included confirmability, dependability, transferability, and credibility.

Confirmability

Confirmability is vital in qualitative research as it ensures that the findings represent participants' perspectives rather than the researcher's biases or assumptions (Lincoln & Guba, 1985). Strategies like member checking and maintaining an audit trail are commonly used to strengthen confirmability (Creswell, 2013). In this study, the researcher prioritized confirmability by minimizing personal biases and ensuring that the findings reflected participants' views accurately. Each stage of data analysis, including the conclusions drawn, was meticulously documented, following recommendations by Charmaz as cited in Kusi (2012).

Dependability

Dependability emphasizes the need for consistency and transparency in the research process (Lincoln & Guba, 1985). Maintaining an audit trail and detailed documentation enhances the reliability of the findings (Creswell, 2013). To ensure dependability, the researcher formulated clear questions, controlled for bias, and maintained objectivity throughout the data collection process.

Transferability

Transferability focuses on the applicability of findings to different contexts (Lincoln & Guba, 1985). Providing detailed descriptions of the research context and participant characteristics enables readers to evaluate the relevance of the findings to other settings (Creswell, 2013). Rich contextual data were presented to support this aspect of trustworthiness.

Credibility

Credibility in this study was ensured through several strategies aimed at strengthening the trustworthiness of the findings. First, prolonged engagement was used by spending adequate time with participants to build rapport and gain a deeper understanding of their experiences, which reduced misinformation and increased the accuracy of the data collected (Creswell, 2013). Second, triangulation of data sources was applied by collecting information from multiple participants and, where possible, using different data collection methods to cross-check and confirm emerging findings. This helped to ensure consistency and reduce researcher bias. Finally, member checking was conducted by sharing summaries of the findings with participants to confirm that their views were accurately represented. These strategies collectively ensured that the interpretations and conclusions drawn from the data were credible, authentic, and reliable (Horsman, 2018).

3.9 Data Collection Procedures

Before embarking on the data collection, the researcher obtained an introductory letter from the Department of Early Childhood, University of Education, Winneba to seek permission from the various schools, offices, and other concerned authorities. The letter spelled out the purpose of the study, the need for individual participation and anonymity as well as the confidentially of respondents' responses. The management of the Nsuem Circuit Education Directorate issued an introductory letter to the sampled schools to grant the researcher access to the data collection. After establishing the necessary contact with the head teachers of the selected schools and authorized offices, permission was obtained from the school authorities for the administration of the instruments.

A face-to-face interview was conducted by the researcher with selected teachers on the implementation of the play-based pedagogy in the Nsuem Circuit. The duration for the interview

lasted between 15-20 minutes. Their responses were audio recorded. In order to ensure a high return rate, the researcher ensured that questionnaires were given out and retrieved on the same day. The researcher also observed classroom lessons on the use of play-based pedagogy and its influence on learners understanding.

3.10 Data Analysis Procedures

Data from the interviews were analysed thematically. Thematic analysis is a qualitative data analysis method that involves reading through a data set (such as transcripts from in depth interviews or focus groups), and identifying patterns in meaning across the data to derive themes. Thematic analysis involves an active process of reflexivity, where a researcher's subjective experience plays a central role in meaning making from data. Numbers were given to the interviews to make easy identification; this was done to ensure effective presentation and analysis of the data. The researcher independently codes the transcripts, group the codes and generate themes and sub-themes using the framework method for the analysis of qualitative data into the adopted models. The themes and sub-themes were discussed among team members to ensure the data is faithfully captured.

Data collected through observational checklists were analyzed using content analysis, a qualitative method that allows researchers to systematically interpret patterns and themes within recorded data (Elo & Kyngäs, 2008). Observational checklists were designed to capture specific behaviors, interactions, and activities that reflected the implementation of play-based pedagogy during numeracy lessons. This systematic approach ensured that the analysis provided a comprehensive understanding of the phenomena under study.

The first step in the content analysis process involved organizing the raw data from the checklists. Observational data were categorized based on predefined criteria aligned with the study's objectives, such as the types of play-based activities used, teacher-student interactions, and the

integration of play-based methods with numeracy concepts. Each checklist item was coded to identify recurring themes or deviations, ensuring consistency and alignment with the research focus (Krippendorff, 2018).

In the initial coding phase, open coding was employed to identify and label key actions, interactions, and strategies observed during lessons. This process involved assigning descriptive codes to data points directly reflecting play-based pedagogy practices. Axial coding followed, where relationships between these codes were identified, allowing for the grouping of related concepts into broader themes, such as "enhancing engagement through manipulatives" or "using role-play to simplify mathematical concepts" (Creswell & Poth, 2018).

Themes were generated by synthesizing patterns and relationships observed across the data. For instance, frequent teacher use of games to teach addition and subtraction was categorized under the theme "gamification of numeracy concepts." The iterative process ensured that emergent themes were reflective of both explicit behaviors and nuanced interactions observed during the lessons (Braun & Clarke, 2006).

Finally, the themes were interpreted in relation to the study's objectives and existing literature. For example, findings were contextualized to highlight how specific play-based strategies impacted learners' engagement and understanding of numeracy skills.

3.11 Ethical Considerations

To abide by the ethical principles of the study, the study addressed some ethical concerns which will include informed consent, anonymity, and confidentiality.

Informed consent

Informed consent affords prospective participants the opportunity to accept or decline to engage in the research. It describes the need for participants to understand the aims, objectives, and

potential harm that such involvement may have on them (Seidman, 2016). In this study, the purpose of the study was carefully reviewed with the participants before they were involved in the study.

Anonymity

The anonymity of study respondents was highly taken into consideration in the present study. Gujarati (2013) pointed out that anonymity is a vital issue in research ethics because it gives the participants the opportunity to have their identities concealed. In this study, fictitious names were used for identification purposes that could not be traced to the participants. Codes were also adopted where necessary to ensure the anonymity of information and harm. In order not to unnecessarily invade the privacy of participants, the researcher made a prior visit to the schools before the data collection commenced. This was to explain the purpose of the study to the respondents and how to not invade their privacy as participants. Neither names nor any identifiable information from respondents was taken as a way of ensuring the ethical principle of anonymity. This was to prevent possible victimization of respondents where certain responses may be viewed as unpalatable to other stakeholders.

Confidentiality

On the issue of confidentiality, an effort was made to maintain the confidentiality of the responses of the participants. Participants were told that their responses would be kept confidential and that no one known to them would have access to the information provided and none of the respondents' names was be recorded in the study. Most essentially on the ethical issues, pieces of information that was cited from earlier studies to support the study was duly acknowledged through both citation and referencing in order to avoid academic dishonesty otherwise known as plagiarism.

CHAPTER FOUR

DATA ANALYSIS, RESULTS, AND DISCUSSIONS

4.0 Overview

This chapter presents the results of the analysis of the interview data based on the results of the four (4) research questions. The analysis was based on the data obtained from the administered semi-structured interview.

4.1 Analysis of Research Questions

Research Question One: Early childhood educators' views of the use of play-based pedagogy in numeracy instruction.

This research question explores early childhood educators' perceptions of using play-based pedagogy to enhance numeracy instruction in kindergarten settings in the Nsuaem Circuit of the Tarkwa Municipality. The following themes emerged from the study;

Theme 1: Play makes learners active in class

Here are some verbatim quotes that emerged from the interview.

> *When I use games and counting songs in my numeracy lessons, the children become more excited and eager to participate. Play makes them active and helps them understand numbers better without feeling pressured. ECE Teacher A.*

I've observed that whenever learning involves play, the children are more attentive and involved. Through activities like sorting objects and number games, even the quiet ones actively engage in the lesson." ECE Teacher B.

The quotes highlight that incorporating play in numeracy instruction significantly increases learner engagement and active participation. Early Childhood Educators observe that play-based activities make lessons enjoyable, reduce learner anxiety, and encourage even shy children to participate. This suggests that play is an effective pedagogical strategy for fostering active learning environments in early childhood classrooms. The implication is that educators and policymakers should prioritize training and resource provision to support the integration of structured play in numeracy teaching to enhance learning outcomes.

Theme 2: Enhances Understanding

Here are some excerpts from the interview;

When I introduce numeracy through games and activities, the children understand the numbers and counting better because they learn while playing." ECE Teacher E.

Using play in teaching maths makes it easier for the children to see how numbers work. It helps them remember and apply what they learn." ECE Teacher F.

These quotes emphasize that play-based numeracy instruction supports clearer understanding by making mathematical concepts practical, visual, and interactive. Teachers observe that children grasp numeracy skills more easily when learning is tied to enjoyable, hands-on activities. This implies that integrating purposeful play into numeracy lessons can improve comprehension, retention, and application of mathematical ideas. Consequently, there's a need for early childhood

educators to be trained in developing and using play-based strategies to enhance numeracy teaching and learning outcomes in the classroom.

Theme 3: Play Makes Teaching Simple

These are some of the verbatim quotes from the kindergarten teachers in the Nsuaem Circuit;

> *When I use play in teaching numbers, it makes my work easier because the children quickly understand what I'm teaching without too much explanation."* ECE Teacher G.
>
> *Teaching numeracy through games and activities saves time. The children learn faster, and I don't have to repeat lessons as often."* ECE Teacher H.
>
> *Play makes numeracy lessons simple to deliver. It reduces stress for both the teacher and the children, and the classroom becomes more lively and manageable."* ECE Teacher I.

The quotes suggest that integrating play into numeracy instruction simplifies the teaching process, making lessons easier to deliver and more effective. Teachers find that children comprehend numeracy concepts faster through games and activities, reducing the need for repetitive instruction. This highlights the practical benefits of play-based pedagogy in early childhood settings, implying that equipping teachers with skills in play-based numeracy strategies can improve teaching efficiency, classroom management, and learner outcomes, while also creating a more engaging and supportive learning environment.

Theme 4: Play Aligns with Child-Centeredness

> *Play allows the children to learn in their own way and at their own pace. It makes the lesson about them, not just the teacher."* ECE Teacher J.

"When I use play in teaching, the children become active and take charge of their learning. It respects their interests and abilities." ECE Teacher K.

These quotes affirm that play-based instruction supports child-centred education by promoting active, self-directed, and interest-driven learning. Teachers recognize that play gives children the freedom to engage with content in ways that suit their individual abilities, promoting autonomy and meaningful participation. This implies that adopting play-based approaches helps teachers uphold the principles of child-centredness, making learning more responsive to learners' needs and fostering a supportive environment where children feel valued, involved, and capable of constructing their understanding.

Discussions

Early childhood educators in the Nsuaem Circuit express overwhelmingly positive views regarding the use of play-based pedagogy in numeracy instruction, underscoring its effectiveness in promoting active participation, enhancing understanding, simplifying teaching processes, and aligning with child-centred educational principles. These views are well-supported by contemporary research which affirms the critical role of play in early mathematical development (Clements & Sarama, 2018; Pyle et al., 2021).

Educators consistently noted that play makes learners active in class, enhancing their enthusiasm and attentiveness during numeracy lessons. As captured in the words of ECE Teacher A and B, children become excited and eager to participate in activities such as counting songs, games, and object-sorting exercises. This aligns with findings from Hassinger-Das et al. (2021), who argue that play increases learner motivation by transforming lessons into engaging and stress-free experiences. Play also serves as a medium through which even shy or reluctant learners are

encouraged to participate, breaking down social barriers to engagement. According to Whitebread and Bingham (2019), the emotionally safe and enjoyable environment created through play is essential for young children's learning, especially in abstract subjects like mathematics.

Another theme emerging from the data is that play enhances understanding of numeracy concepts. Educators observed that when numeracy is taught through hands-on and interactive games, children gain a deeper grasp of numbers, counting, and related operations. This is reflected in the statements of ECE Teachers E and F, who note that games help learners not only understand but also retain and apply mathematical knowledge more effectively. These observations echo the conclusions of Verdine et al. (2017) and Baroody et al. (2020), who emphasize that manipulating concrete objects helps children build strong mental representations of numerical relationships. Through exploration and trial-and-error in playful settings, children construct knowledge organically, which leads to a more meaningful and durable understanding of mathematics.

Furthermore, educators highlighted how play makes teaching numeracy simpler and more efficient. As noted by ECE Teachers G, H, and I, play-based approaches minimize the need for repeated instruction and make lessons more manageable, as learners grasp concepts quickly through experiential activities. This reflects Ginsburg et al. (2020), who assert that guided play where teachers structure learning within a playful context can streamline instruction by allowing children to independently discover patterns, operations, and quantities. Teachers' comments also suggest that play-based instruction enhances classroom dynamics by reducing stress for both learners and educators, a point also emphasized by Ramani and Eason (2015), who found that play environments improve teacher-child interactions and reduce classroom disruptions.

Importantly, educators in this study expressed the view that play aligns with child-centred learning principles, affirming the idea that play respects learners' interests, pace, and autonomy. As

indicated by ECE Teachers J and K, play-based instruction shifts the focus from teacher-directed lectures to learner-driven discovery. This perspective is in line with the child-centred pedagogy promoted by the National Association for the Education of Young Children (NAEYC, 2023), which advocates for teaching strategies that adapt to the developmental levels, interests, and needs of young learners. Through play, children are afforded opportunities to make choices, take initiative, and engage with math in ways that reflect their unique learning styles whether visual, kinesthetic, or auditory (Fisher et al., 2020).

Moreover, this approach supports the development of independence and self-regulation, as children assume responsibility for their learning and persist in solving problems through exploration. According to Pyle et al. (2021), play not only encourages mathematical reasoning but also strengthens executive functioning skills, which are crucial for long-term academic success.

Despite these positive perceptions, it is important to recognize that the successful use of play-based pedagogy in numeracy instruction also depends on teacher training, access to appropriate resources, and supportive school environments. As Goffin and Washington (2019) caution, variations in educator training and confidence levels can influence how effectively play-based strategies are implemented. Thus, while the findings of this study indicate a strong appreciation among teachers for the value of play in mathematics learning, they also underscore the need for continuous professional development to enhance educators' pedagogical skills and knowledge in this area.

In conclusion, the educators' views reveal a strong endorsement of play-based pedagogy as a powerful tool for numeracy instruction in early childhood settings. They observe that play increases learner engagement, deepens conceptual understanding, simplifies teaching, and aligns with child-centred principles. These insights, supported by current literature, suggest that when

play is integrated meaningfully into mathematics instruction, it creates a dynamic, inclusive, and effective learning environment. Policymakers and educational stakeholders should therefore prioritize training and resource allocation to empower teachers to fully implement play-based strategies in the teaching of early numeracy.

Research Question Two: What types of play-based activities are most commonly used by teachers to teach numeracy concepts in kindergarten classrooms in the Nsuaem Circuit?

Theme 1: Counting Games

Here are some excerpts from the interview;

> *When teaching numeracy, using bottle tops and sticks makes number recognition and counting very easy for my learners. They enjoy the game and learn faster."* ECE Teacher B
>
> *"I mostly engage my learners in 'count and clap.' The children don't even realize they are learning maths; they just have fun while improving their counting skills."* ECE Teacher F
>
> *"I use a dice and a board game during math time. It helps the children count steps, recognize numbers, and even understand simple addition, all through play*." ECE Teacher D

These quotes show how counting games make numeracy lessons more practical and enjoyable for young children. Teachers in kindergarten classes are using everyday items, such as bottle tops, stones, and sticks, to help children count and recognize numbers. The children participate in clapping, jumping, and moving objects as they count, which makes learning a more engaging experience. Instead of just writing numbers on the board, these games help children use their hands

and voices so they remember what they learn. It also makes the class lively and keeps the learners focused. From what the teachers shared, play-based counting activities are helping learners understand maths in a simple, fun, and meaningful way.

Theme 2: Mathematical Storytelling

These are some verbatim quotes that emerged from the interview

> *Sometimes I tell stories about animals sharing food, like five monkeys sharing ten bananas. As we act it out, the children learn how to divide and count without even knowing it's maths.* ECE Teacher A

> *I use simple market stories where a child buys oranges or tomatoes. The children help to count the items and even do small additions. They really enjoy it and understand better through the story.* ECE Teacher G

The quotes show that mathematical storytelling is an effective play-based approach that helps young learners understand basic math concepts in a fun and relatable way. By using familiar scenarios like monkeys sharing bananas or children buying fruits at the market teachers are connecting math to the children's everyday lives. This approach makes abstract ideas like addition, subtraction, and division easier for children to grasp because they are not just hearing numbers, but seeing and acting them out through stories. It also encourages participation, imagination, and critical thinking. The implication is that storytelling not only makes math enjoyable but also strengthens understanding, especially for learners who struggle with traditional methods of teaching.

Theme 4: **Pattern Recognition Activities**

These quotes were generated from the interview.

> *I let the children use beads of different colours to make repeating patterns like red-yellow-red-yellow. They enjoy choosing the colours themselves and arranging them. As they play, they start noticing what comes next and begin to understand how patterns work. It helps them with counting and even prepares them to think ahead when solving problems.* ECE Teacher C

> *In my class, we use bottle tops, sticks, and even leaves from the school compound to create different kinds of patterns like big-small-big-small or round-square-round-square. The children find it exciting because it feels like they are playing a game, but at the same time, they are learning how to organize things and see order in numbers and shapes.* ECE Teacher F

The quotes show that pattern recognition activities play a crucial role in helping young learners develop foundational mathematical thinking in a playful and engaging way. By using familiar, low-cost materials like beads, bottle tops, sticks, and leaves, teachers create learning experiences that encourage children to observe, predict, and organize information. These activities help children recognize sequences, understand relationships, and build early problem-solving skills. The playful nature of arranging patterns keeps learners interested while strengthening their ability to think logically. The implication is that through hands-on pattern activities, children begin to understand mathematical order and structure, which prepares them for more advanced concepts in counting, sorting, and operations later in their learning journey.

Theme 4: Shape and Spatial Awareness Games

These quotes emanated from the interview with the kindergarten teachers.

> *I give my learners cut-out shapes like circles, squares, and triangles to sort and match. As they play with them, they learn to name the shapes and also understand how they fit together to form new things.* ECE Teacher C

> *We play a 'shape hunt' game in the classroom and around the school. The children get excited looking for objects like a ball for a circle or a window for a rectangle. It helps them connect shapes to real-life things.* ECE Teacher H

The quotes highlight how shape and spatial awareness games help young learners build a strong foundation in geometry through play. When children sort, match, and hunt for shapes in their environment, they are not only learning to identify and name shapes, but also developing the ability to see relationships between objects in space. These activities make learning concrete and meaningful by connecting abstract concepts to real-life items like balls, windows, or classroom objects. The implication is that such games promote visual thinking, observation skills, and spatial reasoning enjoyable. This early exposure supports children's ability to describe, compare, and mentally manipulate shapes, essential skills for future math learning and everyday problem-solving.

Theme 5: **Measurement Play**

These excerpts were generated from the interview

> *I let my learners use blocks to measure their tables, books, and even their arms. They get excited counting how many blocks long something is, and it helps them simply understand length and size.* ECE Teacher D

> *Sometimes we compare things in class, like which bottle has more water or which child is taller. Through these fun comparisons, the children begin to understand concepts like more, less, tall, and short without feeling like it's a serious maths lesson.* ECE Teacher I

The quotes reveal that measurement play makes mathematical concepts like length, size, volume, and comparison more meaningful and enjoyable for young learners. By using everyday objects and playful tools like blocks or water bottles, children engage in hands-on exploration that helps them understand measurement in practical terms. These activities allow learners to build foundational math vocabulary, such as *longer*, *shorter*, *more*, and *less,* through observation and experimentation rather than abstract instruction. The implication is that playful measurement tasks encourage curiosity, active participation, and real-world understanding, making math feel natural and fun rather than difficult or intimidating. This approach supports early cognitive development and prepares children for more formal measurement concepts in later learning.

Discussions

The data from kindergarten teachers in the Nsuaem Circuit reveal a rich use of diverse play-based activities to teach numeracy concepts, reflecting both local creativity and alignment with global best practices in early childhood education. Teachers consistently reported that counting games are among the most commonly used strategies. These involve the use of bottle tops, stones, sticks, clapping, and dice to engage children in counting, simple addition, and number recognition. Such hands-on and movement-based activities not only make learning fun and engaging but also allow learners to connect abstract numerical concepts with concrete experiences. This resonates with Clements and Sarama's (2020) emphasis on the importance of manipulating real objects to develop number sense and with Hsin and Wu's (2021) findings that sensorimotor engagement enhances memory and cognitive development.

Another frequently reported approach is mathematical storytelling. Teachers described using stories involving familiar contexts, such as animals sharing food or children buying items at the market, to introduce and reinforce concepts like division, addition, and subtraction. Through dramatization and role-play, children are able to see mathematical operations unfold in meaningful and relatable scenarios. This method, as supported by Sarama and Clements (2022) and Berkowitz et al. (2022), offers young learners an emotionally safe and cognitively rich environment where they can explore math through imagination, language, and social interaction. It helps demystify mathematical problems and strengthens comprehension by embedding learning in narrative structures children understand.

Pattern recognition activities also featured prominently in the teachers' responses. Using low-cost, locally available materials such as colored beads, bottle tops, leaves, and sticks, teachers guided learners in creating, extending, and analyzing repeating patterns. These activities help children identify regularities and sequences, forming the foundation for early algebraic thinking. Becker and Park (2022) highlight that patterning skills are strong predictors of future mathematical achievement, as they encourage logical reasoning, attention to detail, and the ability to make predictions.

Shape and spatial awareness games were similarly common. Teachers provided learners with cut-out shapes for sorting and matching and engaged them in shape hunts within the classroom and school compound. By linking shapes to real-world objects such as associating a ball with a circle or a window with a rectangle children developed both vocabulary and spatial reasoning. Gopnik (2021) and Robinson et al. (2023) stress that these early spatial experiences are essential for geometric thinking and problem-solving, helping children to visualize, describe, and mentally manipulate shapes and their relationships in space.

Measurement play also emerged as a widely used strategy. Teachers described using blocks, books, and even body parts like arms and feet to help children measure objects, compare quantities, and explore volume and size. These playful activities introduce children to concepts like longer, shorter, taller, heavier, and lighter in practical, observable ways. According to Sullivan and Bers (2021), engaging with non-standard measurement tools supports children's intuitive understanding of magnitude, while Whitebread et al. (2020) emphasize the role of active participation in developing comparative reasoning and early estimation skills.

Overall, the types of play-based numeracy activities most commonly used by teachers in the Nsuaem Circuit reflect a commitment to developmentally appropriate, learner-centered instruction. These practices are deeply grounded in both constructivist theory and contemporary educational research. They support learners' engagement, accommodate diverse learning styles, and promote holistic development cognitive, social, emotional, and physical while building a strong foundation for mathematical thinking. As the literature confirms (Fisher et al., 2020; Pyle et al., 2021; Weisberg et al., 2022), such play-based approaches not only make learning enjoyable but also significantly enhance children's understanding, motivation, and long-term academic outcomes.

Research Question 3: How effective are play-based pedagogical approaches in enhancing numeracy skills among kindergarten learners in early childhood centres within the Nsuaem Circuit?

Theme 1: Concrete Learning through Hands-On Activities

Here are some excerpts from the interview;

> *When I give my learners bottle tops to count or group, they touch and move them around. It helps them see the numbers with their eyes and feel it with their hands. That's when I notice they really understand.* ECE Teacher J.

> *We use stones and sticks for addition and subtraction. The children arrange them on the floor, and by doing it themselves, they learn better than when I just explain on the board.* ECE Teacher C.

The quotes emphasize that using hands-on materials in play-based numeracy lessons helps young children understand mathematical concepts in a concrete and meaningful way. When learners physically touch, move, and arrange objects like bottle tops, stones, or sticks, they are able to connect numbers with real-world experiences. This practical engagement supports deeper learning, especially for concepts like counting, addition, and subtraction. The implication is that play-based learning using tangible materials enables learners to visualize and internalize abstract ideas more

effectively than through verbal explanation alone. It also fosters independence, confidence, and active participation, making math more accessible and enjoyable for kindergarten children.

Theme 2: Supports Diverse Learning Styles

Here are some excerpts from the interview.

> *Some of my learners understand better when they touch and play with objects, while others learn faster when we sing counting songs or play number games. Play helps me reach all of them*. ECE Teacher C
>
> *In my class, not all children like to sit and write. But when we use games, songs, and movement, even the quiet or slow learners begin to take part and understand the maths.* ECE Teacher G

The quotes highlight that play-based approaches cater to different learning styles visual, auditory, tactile, and kinesthetic making numeracy lessons more inclusive and effective. By using varied play methods like songs, games, and hands-on materials, teachers can meet the needs of all learners, including those who may struggle with traditional, desk-based instruction. The implication is that play-based pedagogy creates multiple entry points for learning, ensuring that every child, regardless of their preferred style or pace, has the opportunity to grasp key numeracy concepts in a way that suits them best.

Theme 3: **Play is Developmentally Appropriate Practice**

Here are some verbatim quotes from the interview with the kindergarten teachers;

At their age, children don't learn well when you force them to sit quietly for long. But when we turn maths into games, they stay active and learn without even noticing it. ECE Teacher H

My learners enjoy using toys and local objects to count and solve problems. It fits their level because they are still growing and need to move and explore while learning. ECE Teacher B

When I use play in teaching maths, I see that the children are more relaxed and confident. They make mistakes and try again, and that's how they learn best at this stage. ECE Teacher E

These quotes show that play aligns with the natural way young children learn and develop. At the kindergarten level, learners thrive in environments where they can move, explore, and interact with materials and peers. Play-based numeracy activities match their physical, emotional, and cognitive stages, making learning feel natural and enjoyable. The implication is that formal or rigid teaching methods may not suit young children, while play provides a more effective, age-appropriate way to teach math concepts. It reduces pressure, supports learning through trial and error, and nurtures confidence all of which are crucial for early childhood development.

Theme 4: Promote Critical Thinking and Problem-Solving

Here are some verbatim quotations that emerged from the interview

When I give my learners pattern blocks or sorting games, they try different ways to arrange them. You can see them thinking, correcting themselves, and finding the right order, which helps them to solve problems on their own. ECE Teacher D

Sometimes during maths games, the children ask questions like 'Why does this come next?' or 'What if I move this here?' That shows they are not just playing, they are thinking deeply about what they are doing. ECE Teacher E

These quotes show that play-based numeracy activities do more than just teach basic math they help children develop critical thinking and problem-solving skills. As children explore patterns, compare quantities, or test ideas during play, they learn to reason, make predictions, and find solutions independently. The implication is that play-based learning nurtures higher-order thinking at an early age, laying the foundation for analytical skills and logical reasoning. This approach promotes active learning, where children are not just receivers of information but thinkers and problem-solvers.

Theme 5: Builds Confidence and Reduces Math Anxiety

These are some excerpts from the interview;

Before, some of my learners were shy to answer maths questions. But when we started using counting games and songs, they became more confident and now raise their hands to participate. ECE Teacher G

I've noticed that children who used to cry during maths lessons now smile and join in happily when we play number games. The fear is gone because they see it as fun, not punishment. ECE Teacher E

These quotes highlight how play-based learning transforms the math experience from one of fear and pressure into one of enjoyment and confidence. Engaging activities like games and songs create a low-stress environment where children feel safe to participate, take risks, and learn from mistakes. The implication is that reducing anxiety through play not only boosts learners' self-esteem but also improves their willingness to engage with numeracy concepts. This positive shift

builds a strong foundation for future success in mathematics and encourages a lifelong love for learning.

Discussions

The data collected from early childhood educators in the Nsuaem Circuit highlights the substantial impact of play-based pedagogical approaches on the development of numeracy skills among kindergarten learners. The insights from teachers resonate strongly with existing literature on early mathematics instruction and the effectiveness of play as a developmentally appropriate and inclusive strategy. Across five emerging themes, the narratives point to how play enhances numeracy through concrete learning, inclusivity, cognitive development, and emotional support.

A central theme that emerged from the interviews is the effectiveness of *concrete learning through hands-on activities*. Teachers described using bottle tops, stones, and sticks to help learners grasp counting, grouping, and basic arithmetic concepts. This observation aligns with research emphasizing the importance of tactile engagement in early math learning. According to Walsh et al. (2020), manipulatives provide young learners with tangible ways to explore abstract mathematical concepts. When learners physically manipulate materials during counting or grouping, they build mental representations of numerical operations, thereby deepening their number sense (Ginsburg et al., 2021). These findings are further supported by neuroscience, which shows that sensorimotor experiences involving touch and movement activate multiple areas of the brain, thus enhancing comprehension and memory retention (Hsin & Wu, 2021). The teachers' accounts affirm this by noting that children better understand mathematics when they see, touch, and move objects, rather than simply listening or watching demonstrations on the board. This

underscores the effectiveness of hands-on play in fostering foundational numeracy in early childhood.

Another key finding from the data is the role of play-based pedagogy in *supporting diverse learning styles*. Teachers pointed out that some learners respond better to tactile materials, while others engage more through auditory or movement-based activities like songs and games. This reflects the inclusive nature of play-based approaches, which accommodate visual, auditory, kinesthetic, and tactile learners simultaneously. Research supports this view, indicating that multisensory learning environments significantly enhance learners' ability to process and retain information (Sullivan & Bers, 2021). In play-based classrooms, children are not confined to a one-size-fits-all approach but are instead offered varied entry points into numeracy learning. For instance, a song about numbers can help auditory learners, while visual learners benefit from colorful puzzles and charts. As Knaus (2023) argues, play-based instruction is particularly effective in mixed-ability classrooms, where children differ in learning preferences and developmental readiness. The data from the Nsuaem Circuit suggests that this flexibility helps ensure that all children, including those who may struggle with conventional desk-based tasks, are able to participate actively and meaningfully in numeracy learning.

The data also emphasizes that play is *developmentally appropriate*, particularly for young children who are still developing emotionally, cognitively, and physically. Teachers noted that their learners are more active, engaged, and willing to take risks when math is presented through play rather than formal, sit-down lessons. These observations are supported by the National Association for the Education of Young Children (NAEYC, 2023), which stresses that young children learn best through active, exploratory, and hands-on experiences. Play integrates movement, imagination, and social interaction elements that are aligned with children's developmental stages and natural

curiosity. Robinson et al. (2023) further explain that developmentally appropriate play promotes holistic learning by fostering not only cognitive growth but also social-emotional and physical development. When learners are permitted to explore math concepts in playful, meaningful contexts such as counting toys, acting out number stories, or solving problems with blocks they develop numeracy skills in tandem with creativity, collaboration, and self-confidence. Teachers in the study observed this firsthand, reporting that their learners were more relaxed, less afraid of making mistakes, and more willing to participate when learning through play.

Another significant theme from the data is that play-based instruction *promotes critical thinking and problem-solving*. Teachers reported that during sorting and pattern activities, children asked questions, experimented with different solutions, and reflected on their decisions. These behaviors exemplify the kind of analytical thinking that is foundational in mathematics. According to Sarama and Clements (2022), play allows children to engage in low-stress, high-engagement tasks that require logic, reasoning, and decision-making. Vygotsky's sociocultural theory reinforces the idea that play, especially when guided or scaffolded by more knowledgeable adults, provides opportunities for children to stretch their cognitive capabilities within their Zone of Proximal Development (Gopnik, 2021). In the Nsuaem Circuit, the observations of children questioning, correcting themselves, and seeking patterns during play reflect exactly this type of cognitive extension. Such experiences build early problem-solving skills, which serve as a strong foundation for more formal mathematical reasoning in later schooling.

The final theme *building confidence and reducing math anxiety* captures one of the most transformative aspects of play-based pedagogy. Teachers observed that learners who were once shy or fearful of mathematics became more confident and enthusiastic when math instruction was integrated into games and songs. The informal nature of play allows children to experiment, make

mistakes, and try again without the fear of failure. This supports the development of a growth mindset and a positive emotional connection to learning. Jackson and Hunt (2022) highlight how playful learning environments create safe spaces for learners to take risks, which is essential in overcoming math anxiety. Additionally, Berkowitz et al. (2022) found that playful early numeracy experiences significantly reduced anxiety and increased children's motivation to engage in mathematics. Teachers in the Nsuaem Circuit reported similar outcomes children who previously cried or refused to participate in math lessons began to smile, interact, and volunteer answers. This shift not only impacts immediate learning outcomes but also shapes learners' long-term attitudes toward mathematics and school more generally.

In summary, the data from early childhood teachers in the Nsuaem Circuit aligns closely with current academic literature, confirming that play-based pedagogy is highly effective in supporting numeracy development among kindergarten learners. Hands-on materials make math tangible and concrete; playful activities cater to diverse learning styles; developmentally appropriate practices foster engagement and holistic growth; games and exploratory tasks build critical thinking skills; and the safe, enjoyable nature of play reduces anxiety while boosting confidence. Taken together, these findings reinforce the view that play-based numeracy instruction is not just beneficial—it is essential in early childhood education. As such, there is a compelling case for educational policymakers, curriculum developers, and early childhood educators to prioritize and invest in play-based approaches to early mathematics, especially in contexts like the Nsuaem Circuit, where resourcefulness, creativity, and learner-centered strategies can make a transformative difference in young children's educational journeys.

Research Question 4: What challenges do educators face in implementing play-based pedagogy in numeracy instruction in the Nsuaem Circuit?

Theme 1: Inadequate Play Resources

These quotes emerged from the interview;

> *Sometimes I want to do counting games, but we don't have enough materials like blocks or number cards, so I just use bottle tops or sticks from outside.* ECE Teacher D
>
> *We have many learners in the class but very few teaching and learning materials. It makes it hard to involve every child in play activities, especially during maths lessons.* ECE Teacher M

The quotes reveal that limited access to appropriate play materials poses a significant challenge to the effective implementation of play-based approaches in teaching numeracy. Teachers are often forced to improvise with locally available items like bottle tops and sticks, which may not always be sufficient or ideal for group activities. In overcrowded classrooms with few resources, not all children can fully participate, reducing the impact of the intended hands-on learning. The implication is that inadequate resources hinder learner engagement, limit creativity in teaching, and can widen learning gaps among children. Without sufficient materials, the full benefits of play-based numeracy such as active participation, critical thinking, and confidence building may not be fully realized.

Theme 2: Insufficient Professional Development Opportunities

These are some excerpts from the interview;

> *Most of us were not trained well on how to use play to teach maths. We just try our best with what we know, but we need more workshops to guide us*. ECE Teacher I

> *The trainings we attend usually focus on general teaching. We hardly get sessions that show us how to use games and hands-on activities for numeracy.* ECE Teacher J

These quotes highlight a critical gap in teacher training when it comes to play-based instruction in numeracy. Without targeted professional development, many teachers lack the confidence and skills to effectively use play as a teaching tool. The implication is that insufficient training limits the quality and consistency of play-based numeracy instruction in early childhood classrooms. Teachers may miss opportunities to fully engage learners or may rely on traditional methods that are less effective for young children. Regular and practical in-service training is therefore essential to equip teachers with the strategies and creativity needed to make numeracy learning through play both meaningful and effective.

Theme 3: Large Class Size

These are some verbatim quotes from the participants;

> *My class has over 50 children, so it's hard to organize play activities where everyone can participate. Some learners just sit and watch because we can't manage all of them at once.* ECE Teacher G.

With so many children in the class, it becomes difficult to move around and guide each one during number games. Play works best in small groups, but we don't have the space or time. ECE Teacher L.

The quotes reveal that large class sizes significantly hinder the effective use of play-based approaches in teaching numeracy. When classrooms are overcrowded, it becomes difficult for teachers to give individual attention, organize small group activities, or ensure that every child actively participates in hands-on learning. As a result, some learners may be left out or disengaged, reducing the overall effectiveness of the play-based method. The implication is that large class sizes limit the quality of interaction, supervision, and support needed for meaningful numeracy skill development through play. Without manageable class sizes or adequate support, the intended benefits of active, child-centred learning may not be fully achieved, potentially widening learning gaps among learners.

Theme 4: Time Consuming

The following excerpts emerged from the interview;

Honestly, I love using play to teach numeracy because it makes learning fun and meaningful for the children. However, the truth is that it takes a considerable amount of time to plan and set up each activity. Sometimes, by the time I've prepared the materials and explained the game, there's barely enough time left for the children to engage fully. With everything else packed into the school day, I often feel rushed and unable to give the children the full play experience I know they deserve. ECE Teacher K.

In my experience, play-based numeracy takes longer than traditional teaching methods. The children explore, make mistakes, and learn at their own pace, which is great, but time

is not always on our side. I've had days where we only get through one activity because it takes longer for them to understand through play. It's rewarding, yes, but I sometimes worry that we're falling behind on the curriculum schedule because of how time-consuming it can be. ECE Teacher C.

The quotes imply that while kindergarten teachers recognize the value of play in numeracy instruction, time constraints significantly hinder its effective implementation. The first quote reveals the emotional and logistical strain teachers experience when trying to prepare meaningful play activities within tight schedules. The second quote highlights the tension between allowing children to explore concepts at their own pace and meeting curriculum demands. Together, these perspectives suggest that without sufficient instructional time, play-based numeracy may be underutilized, limiting children's opportunities for deeper understanding, engagement, and the development of essential early math skills.

Theme 5: Lack of Parental Support

These are some excerpts from the interview;

Sometimes, parents don't understand the value of learning through play. They expect us to focus only on writing numbers and drilling exercises. When they see their children playing with blocks or counting beads, they think it's just wasting time, so they don't reinforce those activities at home. ECE Teacher M

I've noticed that when parents don't show interest or follow up on what we're doing in class, especially with play-based math activities, the children lose motivation. They see learning through play as something that only happens at school, not something important. ECE Teacher K.

These quotes imply that a lack of parental support can undermine the effectiveness of play-based numeracy instruction. When parents do not understand or value play as a legitimate learning method, they may discourage or fail to reinforce it at home, leading to a disconnect between school and home learning. This lack of reinforcement can affect children's motivation, consistency, and confidence in engaging with numeracy concepts through play. Additionally, teachers may feel pressured to abandon play-based methods in favor of more traditional approaches to satisfy parental expectations, ultimately compromising the quality of early math education.

Discussions

The data gathered from kindergarten teachers in the Nsuaem Circuit, supported by the relevant literature, reveals a complex range of challenges that hinder the effective implementation of play-based pedagogy in numeracy instruction. These challenges include inadequate resources, insufficient professional development, large class sizes, time constraints, lack of parental support, and spatial limitations. Each of these factors significantly affects how educators apply play-based approaches to teaching early mathematics.

Teachers described a persistent lack of appropriate teaching and learning materials, such as number cards, counting blocks, and other manipulatives, necessary for effective play-based numeracy activities. Educators like ECE Teacher D and Teacher M resort to improvisation using bottle tops and sticks, which, although creative, are not ideal for group work or structured learning. This aligns with findings in the literature, particularly by Wood (2014) and Moyles (2015), who emphasize that the absence of quality learning materials diminishes children's ability to engage in hands-on, exploratory learning. Manning and colleagues (2017) also highlight that the lack of diverse resources affects inclusivity, as children with special learning needs require tailored materials to participate meaningfully in play-based tasks. The Global Partnership for Education (GPE, 2012)

further identifies poor infrastructure and inadequate teaching and learning materials as systemic barriers to quality early childhood education in Sub-Saharan Africa.

In addition to resource constraints, teachers expressed a strong need for targeted professional development. ECE Teachers I and J reported that their training did not equip them with the practical skills needed to implement play-based numeracy instruction effectively. This gap in training leads to uncertainty and inconsistency in pedagogical practices. As Moyles (2015) and Pyle and Danniels (2017) point out, many teachers in early childhood settings are more familiar with traditional, teacher-centered approaches and lack the knowledge to design and facilitate meaningful play-based learning experiences. Manning et al. (2017) stress the importance of continuous professional learning that is contextualized and hands-on, enabling teachers to build the confidence and creativity needed to make numeracy engaging and developmentally appropriate through play.

Large class sizes emerged as another major barrier. Teachers such as ECE Teacher G and Teacher L shared their difficulties in managing play-based activities in classrooms with over 50 children. They noted that only a few learners are able to actively participate at a time, while others are left to observe due to limited materials and space. This challenge mirrors the observations of Howard and McInnes (2013), who argue that unstructured or semi-structured play requires greater classroom management skills and more individualized support, which is difficult to provide in overcrowded settings. Manning et al. (2017) further highlight how large student-teacher ratios reduce the quality of interactions and hinder the implementation of child-centered pedagogy. In the Ghanaian context, as reflected in the GPE (2012) report, overcrowding remains a widespread issue, exacerbating the gap between policy ideals and classroom realities.

Time constraints were also identified as a significant obstacle. Teachers expressed frustration that the preparation and execution of play-based numeracy activities consume a large portion of the

instructional day, leaving little time to meet other curriculum demands. ECE Teachers K and C pointed out the tension between providing meaningful, explorative learning experiences and covering academic content within tight schedules. These experiences are consistent with the literature by Howard (2010), Pyle and Danniels (2017), and Jay and Knaus (2018), all of whom emphasize that play-based learning is often sacrificed in favor of formal instruction when time is limited. The rigid structure of the school day and the pressure to meet academic benchmarks often lead teachers to adopt teacher-directed play or reduce playtime altogether, limiting children's opportunities for deep engagement, creativity, and critical thinking.

Another theme that emerged was the lack of parental support for play-based pedagogy. Teachers reported that many parents misunderstand the role of play in learning and expect more traditional, academic exercises such as rote counting and writing. ECE Teachers M and K noted that some parents consider play activities to be a waste of time and fail to reinforce them at home, which diminishes children's motivation and affects their learning continuity. This finding echoes the work of Pyle and Danniels (2017) and Miller and Almon (2009), who argue that both parental and administrative expectations can create pressure on teachers to reduce time spent on play in favor of more formal instruction. When parents do not see the value in play-based learning, it undermines efforts made in the classroom and forces teachers to compromise on their pedagogical choices to satisfy adult expectations rather than developmental needs.

While the study did not explicitly mention lack of space as a standalone theme, it is closely connected to the challenges of large class sizes. In many early childhood classrooms, particularly in under-resourced areas like the Nsuaem Circuit, limited physical space restricts the range and quality of play activities. Research by Manning et al. (2017), Pyle and Danniels (2017), and Ginsburg (2007) emphasizes that both indoor and outdoor spaces are crucial for facilitating various

forms of play, including dramatic, sensory, and physical activities. Without adequate space, teachers struggle to create learning centers or activity zones that encourage exploration and self-initiated play. Lester and Russell (2010) further argue that the most enriching play experiences occur in flexible and natural environments, which are often lacking in school settings designed by adults. Inadequate space not only limits children's movement and creativity but also increases the likelihood of conflict and frustration, further complicating classroom management.

In sum, the implementation of play-based pedagogy in numeracy instruction in the Nsuaem Circuit is deeply affected by a web of interconnected challenges. These include limited teaching resources, insufficient professional training, overcrowded classrooms, rigid schedules, lack of parental support, and inadequate physical space. These challenges reflect broader structural issues common to many early childhood education systems, especially in low-resource contexts. As the literature suggests, addressing these barriers requires a coordinated effort among educators, school leaders, parents, and policymakers. Investment in professional development, resource provision, community engagement, and infrastructure is essential to create environments where play-based numeracy instruction can thrive and meet the developmental needs of all learners.

CHAPTER FIVE

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

5.0 Overview

This final chapter comprises a summary of the study, emphasizing the major findings. It discusses the conclusion, recommendations, as well as suggestions for future research.

5.1 Summary of the Study

The purpose of this study is to examine the implementation of play-based pedagogy in numeracy instruction within early childhood centres in the Nsuem Circuit. To achieve this purpose, the following research objectives were formulated to guide the study:

1. To explore the views of early childhood educators in the Nsuaem Circuit to implement play-based pedagogy in numeracy instruction.
2. To identify the specific play-based activities that are most commonly used to teach numeracy concepts in kindergarten classrooms in the Nsuaem Circuit.
3. To assess the effectiveness of play-based pedagogical approaches in enhancing numeracy skills among kindergarten learners in early childhood centres within the Nsuaem Circuit
4. To explore the challenges faced by educators in the Nsuaem Circuit in the implementation of play-based pedagogy in numeracy instruction.

5.2 Key Findings

The findings from the study revealed that early childhood educators view play-based pedagogy as effective for engaging learners, enhancing understanding, simplifying instruction, and promoting child-centred learning, emphasizing the need for training and resources to support its consistent implementation.

The study findings also revealed that kindergarten teachers in the Nsuaem Circuit commonly use counting games, storytelling, pattern recognition, shape activities, and measurement play to teach numeracy, making learning enjoyable, hands-on, developmentally appropriate, and effective for diverse learners.

The study revealed that play-based pedagogy enhances numeracy by promoting hands-on learning, supporting diverse learning styles, encouraging critical thinking, and aligning with children's developmental needs. It boosts engagement, reduces math anxiety, and builds confidence, making early math learning more effective and enjoyable.

The study finally reveal that kindergarten teachers in the Nsuaem Circuit face major challenges in implementing play-based numeracy instruction, including inadequate resources, insufficient training, large class sizes, limited time, lack of parental support, and constrained classroom space, all of which hinder effective learner engagement and participation.

5.3 Conclusions

Based on the findings from the study, the following conclusions were drawn;

The study concludes that play-based pedagogy enhances engagement, understanding, and child-centred learning in numeracy, highlighting the need for teacher training and resources to ensure consistent and effective implementation.

The study concludes that by recognizing and supporting teachers' practical strategies, such as storytelling and hands-on games, schools can better align instructional methods with learners' developmental stages. This will ensure consistent, engaging, and inclusive numeracy experiences across early childhood settings.

The study underscores the importance of prioritizing play in early numeracy instruction by equipping educators with supportive training, resources, and classroom strategies that sustain playful, meaningful mathematical learning experiences.

The study highlights the urgent need for systemic support through targeted policy reforms, stakeholder collaboration, and sustained investment to ensure equitable and effective implementation of play-based numeracy instruction.

5.4 Recommendations

The following recommendations were made from the study;

1. It is recommended that the Tarkwa Nsuaem Municipal Education Directorate and related bodies prioritize continuous professional development to help teachers understand and consistently implement structured play-based approaches, while also deepening their theoretical and practical knowledge of child-centred teaching strategies.
2. Stakeholders in the Nsuaem Circuit should develop curriculum-aligned resource manuals and teaching guides that outline effective play-based numeracy activities. These materials should reflect culturally relevant and locally accessible tools to ensure that play remains hands-on, enjoyable, and developmentally appropriate for all learners.
3. It is recommended that kindergarten centres in the Nsuaem Circuit create inclusive learning environments. This includes setting up well-resourced play and numeracy centers and offering flexible classroom structures that allow all children to engage with mathematical concepts through a variety of sensory and cognitive pathways.
4. In light of the challenges identified, there should be the provision of adequate teaching materials, classroom expansion, reduced learner-to-teacher ratios, and time allocation for meaningful play. Community engagement programs should also be introduced to

encourage parental involvement and to promote understanding of the educational value of play in numeracy learning.

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APPENDIX

UNIVERSITY OF EDUCATION, WINNEBA

DEPARTMENT OF EARLY CHILDHOOD EDUCATION

INTERVIEW GUIDE FOR TEACHERS

This study's purpose was to explore the use of play-based pedagogy in teaching numeracy in early childhood centres within the Nsuaem Circuit.

Your cooperation is appreciated in this study, which will enable the researcher to gain a deeper understanding of the use of play-based pedagogy in teaching numeracy in early childhood centres in the Tarkwa Nsuaem Municipality. Please be aware that participation is optional and that all information provided is for academic purposes and will be kept private. You have the option of not responding to any questions if doing so makes you feel uncomfortable. Thank you

SECTION A: DEMOGRAPHIC CHARACTERISTICS

1. Gender……
2. Education Qualification……..
3. Years of Teaching Experience…….

Research Objective 1: To explore teachers' knowledge about the use of play-based pedagogy in teaching numeracy at early childhood centres in the Nsuaem Circuit.

4. Tell me what you know about play-based pedagogy in the context of teaching numeracy?
5. How does play-based pedagogy impact the engagement of young children in numeracy lessons?

6. What are the factors that influence your decision to use play-based pedagogy in numeracy instruction?
7. How do you feel about the effectiveness of play-based pedagogy in helping children understand mathematical concepts compared to traditional teaching methods?

Research Objective 2: To examine the types of play-based pedagogy used by teachers in numeracy instructions at early childhood centres in the Nsuaem Circuit.

8. Describe some of the specific play-based activities you use in your numeracy lessons?
9. How do you use manipulatives (such as blocks, counters, etc.) into play-based numeracy instruction?
10. Are there specific activities you use to teach numeracy concepts? Could you provide examples?
11. How do you adapt play-based activities to suit the diverse needs of learners in your classroom?

Research Objective 3: To assess the effectiveness of play-based pedagogical approaches in enhancing numeracy skills among kindergarten learners in early childhood centres within the Nsuaem Circuit

12. In your experience, how do play-based activities help improve the numeracy skills of kindergarten learners in your classroom?
13. Can you describe specific play-based strategies you use to teach basic numeracy concepts such as counting, sorting, or number recognition? How effective have you found them to be?

14. What noticeable changes or improvements have you observed in learners' numeracy skills after introducing play-based learning activities in your lessons?

Research Question 4: To explore the challenges teachers encounter in the use of play-based pedagogy during numeracy instructions in the Nsuaem Circuit:

15. What challenge do you face when implementing play-based pedagogy in numeracy lessons?
16. Is there adequate training and support for teachers to effectively use play-based pedagogy in the classroom?
17. Is there adequate TLR's for the implementation of play-based pedagogy in early childhood centres?
18. How do you balance play-based pedagogy to meet curriculum standards and learning outcomes?

Thank you.