# Play-Based Approaches in Developing Early Childhood Learners' Mathematical Skills: Experiences of Teachers in Binga District Primary Schools, Zimbabwe

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**DOI: https://dx.doi.org/10.51244/IJRSI.2026.1307000153**

**Received: 22 July 2026; Accepted: 27 July 2026; Published: 04 August 2026**

## ABSTRACT

Play-based learning has increasingly been recognised as an effective pedagogical approach for promoting young children's mathematical development. Despite its inclusion in Zimbabwe's Early Childhood Development (ECD) curriculum, little is known about teachers' experiences of implementing play-based approaches in rural primary schools. This study explored teachers' experiences with the use of play-based approaches to develop mathematical skills among ECD learners in selected primary schools in Binga District, Zimbabwe. Guided by Piaget's Theory of Cognitive Development, the study adopted a qualitative research approach situated within the interpretivist paradigm. Data were collected from 12 participants, comprising 2 school heads and 10 ECD teachers, using semi-structured interviews and focus group discussions. Participants were selected through purposive and convenience sampling techniques. Data were analysed using thematic analysis.

The findings revealed that play-based learning enhances learners' mathematical understanding by promoting counting, classification, measurement, pattern recognition, problem-solving, communication, and positive attitudes towards mathematics. However, effective implementation was constrained by inadequate teacher training, shortages of instructional materials, overcrowded classrooms, limited instructional time, curriculum pressures, and insufficient institutional support. Participants recommended continuous professional development, increased provision of teaching and learning resources, curriculum flexibility, strengthened school leadership, parental involvement, and collaborative teacher learning as strategies for improving play-based mathematics instruction.

The study concludes that although play-based learning has considerable potential to improve mathematical learning among ECD learners, its successful implementation requires coordinated support from teachers, school leaders, policymakers, teacher education institutions, and communities. The findings contribute context-specific evidence that may inform educational policy, teacher education, curriculum implementation, and future research on play-based mathematics education in resource-constrained rural settings.

**Keywords:** Early Childhood Development, play-based learning, mathematical skills, mathematics education, qualitative research, teachers' experiences.

## INTRODUCTION

Early Childhood Development (ECD) is widely recognised as the foundation upon which lifelong learning and later academic achievement are built. During this developmental stage, children acquire cognitive, social, emotional, language, and psychomotor competencies that shape their future educational experiences and overall development (UNESCO, 2022). Among these competencies, mathematical skills occupy a particularly significant position because they form the basis for logical reasoning, problem-solving, critical thinking, and scientific literacy, which are essential for success in later schooling and everyday life (Clements & Sarama, 2021).

According to Piaget (1952), young children construct knowledge through active interaction with their environment rather than through passive reception of information. This constructivist perspective suggests that learning is most effective when children manipulate objects, explore ideas, experiment with materials, and engage in meaningful experiences that enable them to build new knowledge upon existing cognitive structures. Consequently, play provides a natural and developmentally appropriate context through which young learners acquire foundational mathematical concepts such as counting, sorting, measuring, classifying, sequencing, pattern recognition, and spatial reasoning (Berk, 2018).

Globally, education systems have increasingly embraced play-based learning as an effective pedagogical approach for promoting holistic child development and improving learning outcomes in early childhood education (UNICEF, 2018). Through purposeful play, learners actively construct mathematical knowledge by exploring patterns, counting objects, comparing quantities, recognising shapes, estimating measurements, and solving authentic problems within meaningful social contexts (Clements & Sarama, 2021). Research has consistently demonstrated that play-based pedagogies enhance learner engagement, creativity, communication, collaboration, and higher-order thinking skills while simultaneously strengthening children's conceptual understanding of mathematics (Fleer, 2017; Hirsh-Pasek et al., 2020).

Within the Zimbabwean education system, the Early Childhood Development curriculum advocates learner-centred instructional approaches that recognise play as a critical medium for teaching and learning (Ministry of Primary and Secondary Education, 2015). Despite these policy intentions, classroom practice in many primary schools continues to be characterised by teacher-centred instructional methods that emphasise rote learning, memorisation, and direct instruction at the expense of experiential and play-oriented learning opportunities (Mupa & Chinooneka, 2015). This disconnect between policy and classroom practice has raised concerns regarding the quality of mathematics instruction offered to young learners, particularly in rural schools where educational resources remain limited.

The implementation of play-based mathematics instruction appears to be even more challenging in rural districts such as Binga, where schools frequently experience shortages of instructional materials, overcrowded classrooms, inadequate infrastructure, limited teacher professional development opportunities, and insufficient institutional support. These contextual challenges may constrain teachers' ability to implement meaningful play-based pedagogies despite recognising their educational value (Fleer, 2017; Prochner & Massing, 2020). Furthermore, teachers are often required to balance curriculum coverage with learner-centred instructional approaches, creating additional pressures that may discourage the integration of play into mathematics lessons.

Although considerable international literature demonstrates the educational benefits of play-based learning, relatively little empirical evidence exists regarding how teachers in rural Zimbabwe experience and implement play-based mathematics instruction within their unique educational contexts. Understanding teachers' lived experiences is particularly important because they are central to translating curriculum policy into classroom practice and are directly responsible for creating learning environments that support children's mathematical development (Creswell & Creswell, 2018).

Against this background, the present study investigated teachers' experiences with the use of play-based approaches to develop mathematical skills among Early Childhood Development learners in selected primary schools in Binga District, Zimbabwe. Specifically, the study explored the perceived benefits of play-based mathematics instruction, the challenges teachers encounter during implementation, and the strategies that could strengthen the effective integration of play-based pedagogies into Early Childhood Development mathematics classrooms.

**Statement of the Problem**

Despite the recognition of play-based learning as an effective pedagogical approach for promoting Early Childhood Development (ECD) learners' mathematical skills, its implementation in many Zimbabwean primary schools remains limited and inconsistent. The Zimbabwean ECD curriculum advocates for learner-centred and play-oriented teaching methods (Ministry of Primary and Secondary Education, 2015), yet classroom practices

in many schools continue to be dominated by teacher-centred approaches that emphasise rote learning and memorisation (Mupa & Chinooneka, 2015).

In rural districts such as Binga, the situation is further compounded by contextual challenges including inadequate teaching and learning resources, overcrowded classrooms, limited professional development opportunities, and insufficient institutional support. These constraints hinder teachers' ability to effectively implement play-based mathematics instruction, despite their awareness of its potential benefits for learners' cognitive and mathematical development.

Furthermore, although international literature provides substantial evidence on the effectiveness of play-based learning, there is limited context-specific empirical evidence on how teachers in rural Zimbabwe experience and implement play-based approaches in teaching mathematical skills. The lived experiences, challenges, and coping strategies of teachers in such resource-constrained environments remain underexplored.

This gap in knowledge limits the ability of policymakers, curriculum developers, and teacher educators to design contextually relevant interventions that support effective implementation of play-based mathematics instruction in Early Childhood Development classrooms. It is therefore against this background that this study sought to explore teachers' experiences of using play-based approaches in developing mathematical skills among ECD learners in selected primary schools in Binga District, Zimbabwe.

**Research objectives**

**General objective**

To explore teachers' experiences with the use of play-based approaches to develop mathematical skills among Early Childhood Development learners in selected primary schools in Binga District, Zimbabwe.

**Specific Objectives**

1. To examine teachers' perceptions of the benefits of play-based approaches in developing ECD learners' mathematical skills.

2. To identify the challenges affecting the implementation of play-based mathematics instruction in selected primary schools.

3. To explore strategies that can strengthen the implementation of play-based approaches in developing mathematical skills among ECD learners.

**Research questions**

1. What benefits do teachers perceive play-based approaches to have in developing Early Childhood Development learners' mathematical skills?

2. What challenges do teachers encounter when implementing play-based mathematics instruction in selected primary schools in Binga District?

3. What strategies can strengthen the implementation of play-based approaches in developing mathematical skills among Early Childhood Development learners?

## LITERATURE REVIEW

**Play-Based Learning in Early Childhood Development**

Play-based learning has become one of the most widely advocated pedagogical approaches in Early Childhood Development (ECD) because it provides young learners with opportunities to actively construct knowledge through exploration, experimentation, and social interaction (UNICEF, 2018). Contemporary educational

research recognises purposeful play as more than a recreational activity; rather, it is an effective instructional strategy that promotes children's cognitive, social, emotional, language, and physical development (Berk, 2018). Within mathematics education, play creates authentic learning contexts in which children manipulate concrete materials, solve practical problems, and develop foundational mathematical concepts through meaningful experiences.

The theoretical foundations of play-based learning are rooted in constructivist perspectives. Piaget (1952) argued that children actively construct knowledge through interaction with their environment via the complementary processes of assimilation and accommodation. During the pre-operational stage, which corresponds with the ECD phase, children learn mathematical concepts more effectively when they manipulate concrete objects than when they receive abstract explanations. Consequently, activities such as counting games, block construction, sorting, puzzles, role-play, and pattern-making enable learners to construct mathematical understanding through active exploration. Similarly, Vygotsky (1978) emphasised that learning occurs through social interaction, suggesting that collaborative play provides opportunities for children to develop higher-order thinking through interaction with peers and teachers.

**Play-Based Learning and the Development of Mathematical Skills**

A substantial body of empirical literature demonstrates that play-based learning contributes significantly to children's mathematical development. According to Clements and Sarama (2021), play enables learners to develop number sense, counting skills, measurement concepts, spatial reasoning, classification, pattern recognition, estimation, and problem-solving through active engagement with mathematical tasks. Likewise, Hirsh-Pasek et al. (2020) found that guided play promotes deeper conceptual understanding by encouraging learners to explore ideas, ask questions, test hypotheses, and discover mathematical relationships independently. Such learner-centred experiences enable children to construct conceptual understanding that extends beyond procedural knowledge.

Research further suggests that play-based learning positively influences learners' attitudes towards mathematics. Fleer (2017) observed that playful learning environments reduce mathematics anxiety while increasing learners' confidence, curiosity, creativity, and willingness to participate in classroom activities. Similarly, Berk (2018) argued that meaningful play stimulates intrinsic motivation because learners engage with instructional materials in enjoyable and developmentally appropriate ways. As a result, learners become more willing to communicate mathematical ideas, collaborate with peers, and persist when solving challenging mathematical problems.

Collectively, these studies indicate that play-based learning contributes not only to mathematical achievement but also to the broader cognitive, social, and emotional development that supports lifelong learning.

**Factors Influencing the Implementation of Play-Based Mathematics Instruction**

Although the educational benefits of play-based learning are well documented, its successful implementation depends largely on the competence of teachers and the availability of supportive learning environments. Creswell and Creswell (2018) emphasised that teachers play a central role in designing meaningful learning experiences that promote active learner participation. Similarly, Prochner and Massing (2020) argued that teachers require specialised pedagogical knowledge to integrate play effectively into mathematics instruction while simultaneously achieving curriculum objectives. Without adequate professional preparation, teachers may struggle to balance learner-centred play activities with curriculum expectations.

The availability of instructional resources is another critical determinant of effective implementation. Fleer (2017) noted that play-based mathematics instruction requires manipulatives, puzzles, counting objects, games, number cards, and outdoor play equipment that allow learners to explore mathematical concepts concretely. However, UNESCO (2022) observed that resource shortages remain a persistent challenge in many developing countries, particularly in rural schools where financial constraints limit access to appropriate teaching and learning materials. Consequently, many teachers rely on improvised materials or traditional teaching approaches that provide fewer opportunities for experiential mathematical learning.

Curriculum requirements also influence teachers' instructional practices. Hunter (2019) reported that teachers frequently experience pressure to complete prescribed syllabi within limited instructional time, making it difficult to allocate sufficient time for learner-centred play activities. Furthermore, assessment systems that emphasise written examinations often encourage teacher-centred instruction rather than observation-based assessment practices that are more consistent with play-based learning (Clements & Sarama, 2021). As a result, teachers may perceive play-based instruction as competing with curriculum coverage rather than complementing it.

**Challenges of Implementing Play-Based Learning in Resource-Constrained Contexts**

Evidence from developing countries consistently identifies several barriers that hinder the implementation of play-based pedagogies. Fleer (2017) reported that inadequate teacher training, overcrowded classrooms, insufficient instructional materials, limited infrastructure, and weak institutional support constrain teachers' ability to implement meaningful play activities. Similarly, Prochner and Massing (2020) found that effective implementation requires continuous professional development, mentoring, administrative support, and adequate educational resources.

Within Zimbabwe, studies examining play-based learning have largely focused on general ECD curriculum implementation, learner participation, and child-centred pedagogies, with relatively limited attention given to play-based approaches for developing mathematical skills (Mupa & Chinooneka, 2015). Furthermore, the available literature provides limited insight into teachers' experiences in rural districts where contextual challenges differ considerably from those encountered in urban schools. Rural schools often experience shortages of instructional resources, inadequate infrastructure, limited professional development opportunities, and insufficient institutional support, all of which directly influence classroom practice.

These findings suggest that successful implementation of play-based mathematics instruction requires coordinated support involving governments, school leaders, teacher education institutions, communities, and parents to create enabling learning environments.

**Research Gap**

Despite the growing body of literature demonstrating the effectiveness of play-based learning in early childhood education, important gaps remain in the existing scholarship. Internationally, most empirical studies have been conducted in developed countries where schools generally have adequate instructional resources, well-trained teachers, favourable teacher-learner ratios, and supportive learning environments that facilitate the successful implementation of play-based pedagogies (Fleer, 2017; Hirsh-Pasek et al., 2020). These studies consistently report that play-based learning enhances young children's mathematical reasoning, problem-solving abilities, learner engagement, creativity, and overall cognitive development (Clements & Sarama, 2021). However, as UNESCO (2022) observes, the contextual realities of resource-constrained educational settings in developing countries remain insufficiently represented in the literature, limiting the transferability of these findings to rural African contexts.

Within the Zimbabwean context, existing research has largely concentrated on broad aspects of Early Childhood Development, including curriculum implementation, learner participation, language development, and child-centred pedagogies (Ministry of Primary and Secondary Education, 2015; Mupa & Chinooneka, 2015). Comparatively little scholarly attention has been devoted to examining the specific use of play-based approaches in developing mathematical skills among Early Childhood Development (ECD) learners. Consequently, there is limited empirical evidence on how play-based pedagogies contribute to the acquisition of foundational mathematical competencies such as counting, number recognition, pattern recognition, measurement, spatial reasoning, and problem-solving within Zimbabwean ECD classrooms.

Furthermore, the few available studies on play-based learning in Zimbabwe have predominantly focused on urban or relatively well-resourced educational settings, leaving rural districts such as Binga largely underrepresented in the literature. Rural schools often experience unique contextual challenges, including shortages of instructional materials, inadequate infrastructure, overcrowded classrooms, limited professional

development opportunities, and insufficient institutional support, all of which may significantly influence teachers' instructional practices and the effectiveness of play-based mathematics teaching (Fleer, 2017; Prochner & Massing, 2020). As Creswell and Creswell (2018) argue, understanding educational phenomena within their natural contexts is essential for generating contextually relevant knowledge capable of informing policy and practice.

Methodologically, much of the existing literature has employed quantitative approaches that primarily measure learner outcomes or evaluate programme effectiveness (Clements & Sarama, 2021). While such studies have generated valuable evidence regarding the effectiveness of play-based learning, they provide relatively limited understanding of teachers' lived experiences, perceptions, implementation challenges, and practical strategies for integrating play-based mathematics instruction into everyday classroom practice. Consequently, there remains insufficient qualitative evidence explaining how teachers navigate contextual constraints while implementing learner-centred pedagogies in rural Zimbabwean primary schools.

This study addresses these identified gaps by adopting a qualitative approach to explore the experiences of Early Childhood Development teachers and school heads regarding the implementation of play-based approaches in developing learners' mathematical skills in selected primary schools in Binga District, Zimbabwe. By providing rich, context-specific evidence from a resource-constrained rural setting, the study extends the existing body of knowledge on play-based mathematics education and contributes empirical insights that may inform teacher education, educational policy, curriculum implementation, and future research within Zimbabwe and other comparable developing-country contexts.

**Theoretical Framework**

This study was guided by Piaget's Theory of Cognitive Development, which provides a robust theoretical foundation for understanding how young children acquire mathematical knowledge through active engagement with their environment. Developed by Jean Piaget, the theory posits that children are active constructors of knowledge rather than passive recipients of information. Piaget (1952) argued that cognitive development occurs through continuous interaction between children and their physical and social environments, where learning is facilitated by exploration, manipulation of objects, experimentation, and meaningful play. This constructivist perspective has significantly influenced contemporary early childhood education by emphasising learner-centred instructional approaches that promote active participation in the learning process.

According to Piaget (1952), cognitive development occurs through two complementary processes: assimilation and accommodation. Assimilation involves integrating new experiences into existing cognitive structures or schemas, while accommodation refers to modifying existing schemas to incorporate new knowledge and experiences. As children encounter unfamiliar situations during play, they continuously adapt their thinking by balancing these two processes through what Piaget described as equilibration (Berk, 2018). This dynamic process enables learners to progressively construct more sophisticated understandings of mathematical concepts through interaction with concrete learning experiences rather than through direct instruction alone.

Piaget (1952) further proposed that children progress through four sequential stages of cognitive development: the sensorimotor stage, the pre-operational stage, the concrete operational stage, and the formal operational stage. Of particular relevance to this study is the pre-operational stage, which typically encompasses children between the ages of approximately two and seven years and corresponds with the Early Childhood Development (ECD) phase in Zimbabwe. During this stage, children learn most effectively through concrete experiences involving the manipulation of physical objects rather than through abstract explanations or symbolic instruction (Clements & Sarama, 2021). Consequently, instructional approaches that encourage active exploration, experimentation, and play are considered developmentally appropriate for promoting mathematical understanding among young learners.

Within mathematics education, Piaget's theory suggests that foundational mathematical concepts are best acquired when learners actively manipulate concrete materials and engage in meaningful problem-solving activities. Play-based instructional activities such as counting games, puzzles, block construction, sorting and matching exercises, role-play, pattern-making, and measurement activities enable learners to develop concepts

of number, shape, classification, sequencing, measurement, spatial reasoning, and logical thinking through firsthand experiences (Fleer, 2017). According to Clements and Sarama (2021), these play experiences allow children to construct mathematical knowledge by exploring relationships among objects, identifying patterns, making comparisons, and solving practical problems within authentic learning contexts.

The theory also redefines the role of the teacher within the learning process. Rather than serving primarily as a transmitter of knowledge, the teacher becomes a facilitator who designs rich learning environments, provides appropriate materials, observes children's learning, and guides learners through questioning and scaffolding to promote deeper understanding (Berk, 2018). In play-based mathematics instruction, teachers encourage exploration, curiosity, collaboration, and reflective thinking while allowing learners sufficient autonomy to discover mathematical concepts independently. Such learner-centred pedagogical practices are consistent with contemporary approaches to Early Childhood Development that emphasise active learning and experiential education (UNICEF, 2018).

Piaget's Theory of Cognitive Development was therefore considered appropriate for the present study because it provides a comprehensive theoretical lens for explaining how play facilitates the development of mathematical understanding among Early Childhood Development learners. The theory helps explain why play-based instructional approaches are effective in promoting foundational mathematical competencies through active engagement with concrete learning materials. Furthermore, it provides an appropriate framework for examining teachers' experiences regarding the implementation of play-based mathematics instruction in rural primary schools, where contextual factors such as teacher competence, instructional resources, classroom environments, and institutional support may influence the quality of learners' mathematical experiences. By grounding the study within Piaget's constructivist perspective, the research offers a theoretically informed understanding of how play-based pedagogies contribute to mathematical learning in resource-constrained Early Childhood Development classrooms.

**Conceptual Framework**

The conceptual framework for this study illustrates the relationships among the factors influencing the implementation of play-based learning and the development of mathematical skills among Early Childhood Development (ECD) learners. Conceptual frameworks provide a visual and theoretical representation of the variables under investigation and demonstrate how these variables are expected to interact in addressing the research problem (Creswell & Creswell, 2018). In qualitative research, a conceptual framework serves as a guide for data generation, analysis, and interpretation by linking theoretical propositions to the practical realities of the study (Maxwell, 2013).

Drawing upon Piaget's Theory of Cognitive Development (Piaget, 1952) and existing literature on play-based learning (Clements & Sarama, 2021; Fleer, 2017), this study conceptualises the development of learners' mathematical skills as the dependent variable that is influenced by several interrelated instructional and contextual factors. The framework assumes that the successful implementation of play-based mathematics instruction depends on the availability of enabling conditions within the school environment, the competence of teachers, and the support provided by relevant stakeholders.

The independent variables comprise teacher professional competence, availability of play materials, school support, curriculum flexibility, classroom environment, and play-based instructional strategies. These variables represent the key institutional and instructional conditions that determine the extent to which teachers can effectively implement play-based learning. According to Prochner and Massing (2020), teachers who possess adequate pedagogical knowledge and access to appropriate instructional resources are more likely to create engaging play-based learning experiences that foster children's mathematical development. Similarly, Fleer (2017) argues that supportive school leadership, adequate classroom resources, and flexible curricula are essential prerequisites for effective implementation of learner-centred pedagogies.

The framework further recognises that the relationship between these instructional factors and learner outcomes is influenced by several mediating factors, namely teacher attitudes, teacher creativity, administrative support, parental involvement, and the availability of educational resources. As Berk (2018) notes, teachers' beliefs and

attitudes towards play-based learning significantly influence how frequently and effectively they incorporate play into classroom instruction. Likewise, administrative support and parental involvement create enabling environments that encourage the adoption of innovative teaching approaches, while teacher creativity enables the improvisation of locally available materials in resource-constrained settings (UNESCO, 2022).

The dependent variable in this study is the development of Early Childhood Development learners' mathematical skills. These skills include counting, number recognition, pattern recognition, classification, measurement, problem-solving, spatial reasoning, mathematical communication, and the development of positive attitudes towards mathematics. According to Clements and Sarama (2021), these competencies constitute the foundational mathematical knowledge upon which later mathematical learning is built. Through meaningful play, learners actively manipulate objects, explore mathematical relationships, communicate ideas, and solve practical problems, thereby constructing conceptual understanding that extends beyond memorisation and procedural learning.

Grounded in Piaget's constructivist perspective, the framework assumes that when teachers are professionally competent, adequately supported, and provided with appropriate instructional resources, they are better positioned to implement effective play-based instructional strategies. These strategies encourage learners to actively engage in mathematical exploration, experimentation, collaboration, and problem-solving, resulting in improved mathematical understanding and broader cognitive development (Piaget, 1952). Conversely, deficiencies in teacher preparation, instructional resources, curriculum support, or institutional commitment may constrain the successful implementation of play-based mathematics instruction and ultimately limit learners' opportunities to acquire essential mathematical competencies.

Accordingly, the conceptual framework guided the formulation of the research questions, informed the development of the data collection instruments, and provided an analytical lens for interpreting teachers' experiences regarding the implementation of play-based approaches in developing mathematical skills among ECD learners in selected primary schools in Binga District, Zimbabwe.

Figure 1

Conceptual Framework Showing Factors Influencing the Development of ECD Learners' Mathematical Skills Through Play-Based Learning

**Independent Variables**

• Teacher Professional Competence

• Play Materials

• School Support

• Curriculum Flexibility

• Classroom Environment

• Play-Based Teaching Strategies

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**Mediating Variables**

• Teacher Attitudes

• Teacher Creativity

• Administrative Support

• Parental Involvement

• Resource Availability

**Dependent Variable**

Development of Mathematical Skills

• Counting

• Number Recognition

• Classification

• Pattern Recognition

• Measurement

• Spatial Reasoning

• Problem Solving

• Mathematical Communication

• Positive Attitudes

**Source:** Researcher's conceptualisation based on Piaget (1952) and literature reviewed (2024).

## METHODOLOGY

This study adopted a qualitative research approach grounded in the interpretivist research paradigm. The interpretivist paradigm assumes that reality is socially constructed and that understanding a phenomenon requires exploring participants' experiences, meanings, and interpretations within their natural settings (Creswell & Creswell, 2018). Accordingly, the qualitative approach was considered appropriate because it enabled the researcher to obtain rich, in-depth insights into teachers' experiences regarding the implementation of play-based approaches in developing Early Childhood Development (ECD) learners' mathematical skills. As Creswell (2014) argues, qualitative research is particularly suitable for investigating complex educational phenomena where participants' perspectives, beliefs, and lived experiences are central to understanding the issue under investigation.

The study was conducted in four purposively selected primary schools within the Cluster X schools, i.e., two main schools and their annex schools, in Binga North District, Matabeleland North Province. The district is predominantly rural and is characterised by limited educational resources, infrastructural constraints, and socio-economic challenges that may influence the implementation of learner-centred pedagogical approaches. The selection of the study site was informed by the need to explore teachers' experiences within a resource-constrained rural context where play-based mathematics instruction is likely to encounter unique implementation challenges.

A total of twelve participants were selected using purposive and convenience sampling techniques, both of which are widely employed in qualitative research to identify information-rich participants capable of providing

detailed insights into the phenomenon under investigation (Patton, 2015). The sample comprised two school heads and ten Early Childhood Development teachers drawn from the selected primary schools. School heads were purposively selected because of their leadership roles and oversight responsibilities regarding curriculum implementation and instructional practices. Conversely, ECD teachers were conveniently selected based on their accessibility, availability, and direct involvement in teaching mathematics through play-based approaches.

Data were generated using semi-structured interviews and focus group discussions, allowing for methodological triangulation and enhancing the credibility of the findings (Cohen et al., 2018). Semi-structured interviews were conducted with the two school heads to explore their experiences, perceptions, and administrative perspectives regarding the implementation of play-based mathematics instruction. Focus group discussions involving the ten ECD teachers provided opportunities for participants to collectively reflect on their classroom experiences, discuss implementation challenges, and propose strategies for strengthening play-based learning. The use of open-ended questions enabled participants to express their views freely while allowing the researcher to probe emerging issues for greater depth and clarification (Kabir, 2016).

The collected data were analysed using thematic analysis, a widely accepted qualitative data analysis technique that facilitates the systematic identification, organisation, and interpretation of recurring patterns within textual data (Braun & Clarke, 2006). Following data transcription, the researcher familiarised himself with the interview and focus group transcripts through repeated reading. Initial codes were then generated from meaningful segments of the data before being organised into broader categories. These categories were subsequently refined into overarching themes that addressed the study objectives and reflected participants' experiences regarding the benefits, challenges, and strategies associated with play-based mathematics instruction. Throughout the analysis process, themes were continuously reviewed and compared with existing literature to enhance the interpretive depth and credibility of the findings.

To enhance the trustworthiness of the study, the researcher adhered to the qualitative quality criteria proposed by Lincoln and Guba (1985), namely credibility, transferability, dependability, and confirmability. Credibility was strengthened through methodological triangulation involving interviews and focus group discussions, while detailed descriptions of the research context and participants enhanced transferability. Dependability was promoted by maintaining a clear audit trail documenting the research procedures, whereas confirmability was supported through careful documentation of data collection and analysis processes to minimise researcher bias.

Ethical principles were strictly observed throughout the research process. Institutional approval to conduct the study was obtained from the relevant educational authorities before data collection commenced. In addition, informed consent was obtained from all participants after they had been adequately informed about the purpose of the study, their rights as participants, and the voluntary nature of their participation. Participants were assured of confidentiality and anonymity, and pseudonyms were used during data presentation to protect their identities. Participants were also informed of their right to withdraw from the study at any stage without any negative consequences, consistent with established ethical principles governing educational research (Cohen et al., 2018). These ethical safeguards ensured that the dignity, privacy, and rights of all participants were protected throughout the study.

## RESULTS

The findings are presented according to the three research objectives: (i) the perceived benefits of play-based approaches in developing learners' mathematical skills, (ii) the challenges affecting the implementation of play-based mathematics instruction, and (iii) strategies for strengthening the implementation of play-based learning in Early Childhood Development (ECD) classrooms. Data generated from semi-structured interviews and focus group discussions were analysed thematically, and illustrative quotations are presented to support the emerging themes.

**Benefits of Play-Based Learning in Developing Mathematical Skills**

Participants consistently described play-based learning as an effective instructional approach for enhancing young learners' mathematical understanding. Across both interviews and focus group discussions, respondents indicated that play enabled learners to interact with concrete materials, thereby facilitating the acquisition of foundational mathematical concepts through active participation and exploration. Teachers reported that learners developed stronger competencies in counting, sorting, measurement, classification, pattern recognition, and problem-solving by participating in games and other manipulative activities.

One school head explained:

*"Play allows learners to manipulate objects and understand mathematical concepts practically rather than memorising them."* (School Head 1)

This finding suggests that play-based learning shifts mathematics instruction from rote memorisation towards experiential learning, allowing learners to construct mathematical knowledge through direct interaction with their environment. Participants further observed that learners became more confident when mathematical concepts were presented through enjoyable and meaningful play activities.

Teachers also reported that play-based instruction contributed to several broader educational outcomes beyond mathematical competence. These included increased learner motivation, critical thinking, communication skills, teamwork, creativity, confidence in mathematics, and positive attitudes towards learning mathematics. During the focus group discussions, participants explained that collaborative games encouraged learners to communicate mathematical ideas, negotiate solutions, and learn from one another while solving practical tasks.

One teacher remarked:

*"When learners play together, they discuss numbers, compare objects, and solve problems as a team. They become more confident because learning feels enjoyable rather than difficult."* (FGD Participant)

These findings indicate that play-based learning not only enhances conceptual understanding but also promotes the development of higher-order thinking skills and positive learner dispositions. The results corroborate those of Clements and Sarama (2021), who found that play-based instructional approaches promote conceptual understanding, mathematical reasoning, and learner engagement through meaningful interaction with learning materials. Similarly, Fleer (2017) observed that playful learning environments increase learners' curiosity, motivation, and confidence while reducing anxiety associated with mathematics. The findings also align with Piaget's (1952) constructivist theory, which posits that children construct knowledge through active exploration and manipulation of concrete objects.

**Challenges Affecting the Implementation of Play-Based Mathematics Instruction**

Although participants acknowledged the educational benefits of play-based learning, they consistently identified several challenges that hinder its effective implementation in ECD classrooms. The most frequently reported challenge was inadequate professional preparation. Most teachers indicated that they had never received specialised training in play-based mathematics pedagogy and therefore relied largely on personal experience and improvisation when implementing play-based activities.

One participant stated:

*"We appreciate the importance of play, but most of us have never been trained on how to teach mathematics using play-based approaches."* (FGD Participant)

The findings suggest that insufficient professional development limits teachers' confidence and competence in designing and facilitating effective play-based mathematical activities. Participants also expressed concerns regarding the limited availability of teaching and learning resources. Schools were reported to experience

shortages of manipulatives, educational games, puzzles, toys, books, and other instructional materials necessary for implementing meaningful play-based learning experiences.

Beyond resource limitations, respondents identified several additional constraints, including curriculum overload, limited instructional time, overcrowded classrooms, inadequate play spaces, assessment practices that favour traditional written tasks, and parental expectations that prioritise teacher-centred instruction. School heads explained that balancing curriculum coverage with learner-centred pedagogies remained difficult under existing educational requirements.

One school head commented:

*"Teachers are expected to complete the syllabus within a limited time, making it difficult to allocate sufficient time for meaningful play activities."* (School Head 2)

The findings indicate that these institutional and contextual challenges collectively reduce teachers' ability to integrate play effectively into mathematics instruction. Similar challenges have been documented by Prochner and Massing (2020), who identified inadequate teacher preparation, limited instructional resources, and curriculum demands as major barriers to implementing play-based pedagogies. Likewise, UNESCO (2022) reports that many schools in low-resource settings struggle to operationalise learner-centred approaches because of shortages of educational resources and limited institutional support.

**Strategies for Strengthening Play-Based Mathematics Instruction**

Participants proposed several practical strategies that could improve the implementation of play-based mathematics instruction within ECD classrooms. The most frequently recommended intervention was the provision of continuous professional development programmes focusing specifically on play-based mathematics pedagogy. Participants believed that regular workshops, mentoring programmes, and in-service training would strengthen teachers' pedagogical knowledge and confidence in implementing learner-centred instructional approaches.

One participant observed:

*"Regular training would help teachers understand how to design meaningful mathematical play activities and assess learners more effectively."* (FGD Participant)

Participants also recommended increasing the provision of teaching and learning materials through greater government investment and school-based resource mobilisation initiatives. Teachers emphasised that locally available materials could be creatively utilised to develop low-cost instructional resources suitable for play-based mathematics instruction. They further suggested curriculum review to provide greater flexibility for integrating play into mathematics lessons without compromising curriculum coverage.

Other strategies proposed included promoting teacher collaboration through professional learning communities, strengthening mentoring relationships between experienced and novice teachers, increasing parental awareness regarding the educational value of play, and adopting observation-based assessment techniques that are more appropriate for evaluating learning achieved through play.

As one school head explained:

*"Successful implementation requires teachers, parents, school administrators and education authorities to work together in supporting children's learning through play."* (School Head 1)

These findings underscore the importance of adopting a holistic approach to strengthening play-based mathematics instruction. The suggested strategies are consistent with Hunter (2019), who advocates collaborative professional learning among teachers to improve innovative instructional practices. Similarly, Prochner and Massing (2020) emphasise that effective implementation of play-based learning requires sustained professional development, adequate instructional resources, supportive educational leadership, and active

parental involvement. Collectively, the findings suggest that improving play-based mathematics instruction requires coordinated efforts among teachers, school leaders, policymakers, teacher education institutions, and communities to create enabling environments that support meaningful mathematical learning in Early Childhood Development classrooms

# DISCUSSION

The findings of this study demonstrate that play-based learning supports learners' mathematical development by enabling them to construct knowledge through meaningful interaction with learning materials. These results are consistent with Piaget's Theory of Cognitive Development, which emphasises active learning through exploration and manipulation of concrete objects as a foundation for cognitive growth.

The reported benefits also align with previous research indicating that play-based approaches enhance learners' conceptual understanding, mathematical reasoning, motivation, and confidence. Through active engagement, learners can internalise abstract mathematical concepts more effectively, thereby improving both performance and attitude towards mathematics.

However, the study also reveals persistent implementation challenges that are commonly reported in developing country contexts. These include inadequate teacher preparation, limited instructional resources, and rigid curriculum structures, all of which hinder the effective application of play-based learning despite existing policy support for learner-centred pedagogies.

The findings further suggest that the successful integration of play-based mathematics instruction requires comprehensive systemic interventions. These include strengthened teacher professional development, increased curriculum flexibility, improved institutional support, and adequate allocation of teaching and learning resources.

# CONCLUSION

The study concludes that play-based learning constitutes an effective pedagogical approach for developing mathematical skills among Early Childhood Development learners. Teachers acknowledged substantial benefits including improved conceptual understanding, learner engagement, collaboration, critical thinking, and positive attitudes towards mathematics.

Nevertheless, implementation remains constrained by inadequate teacher training, insufficient teaching resources, curriculum pressures, overcrowded classrooms, and limited assessment strategies.

Addressing these challenges requires coordinated efforts involving government, teacher education institutions, school leadership, and local communities.

# ACKNOWLEDGEMENTS

The authors would like to thank all colleagues, institutional staff, and anonymous contributors who provided valuable insights and technical assistance during this research.

**Implications for Policy and Practice**

The findings suggest that successful implementation of play-based mathematics instruction requires policy interventions that strengthen teacher professional development, improve resource allocation, and enhance institutional support. Curriculum policies should provide sufficient flexibility for learner-centred instructional approaches, while teacher education programmes should place greater emphasis on practical play-based pedagogies. School leaders should establish supportive environments that encourage innovation, collaboration, and continuous professional learning.

**Contribution to Knowledge**

This study makes several theoretical, methodological, and practical contributions to the body of knowledge on Early Childhood Mathematics Education.

First, the study provides empirical evidence on the implementation of play-based mathematics instruction in rural Zimbabwean primary schools, an area that remains underrepresented in the existing literature. While previous studies have largely focused on urban settings or developed countries, this study provides context-specific insights from Binga District, thereby broadening understanding of play-based pedagogy in resource-constrained educational environments.

Second, the study extends the application of Piaget's Theory of Cognitive Development by demonstrating how play-based instructional practices facilitate mathematical learning among ECD learners within rural African classrooms. The findings reinforce the relevance of constructivist learning theories in contemporary mathematics education while highlighting contextual factors that influence successful implementation.

Third, the study contributes practical knowledge by identifying the major barriers limiting effective implementation of play-based mathematics instruction, including inadequate teacher training, shortages of instructional resources, curriculum pressures, and limited institutional support. These findings provide evidence that can inform educational policy and teacher professional development programmes.

Fourth, the study proposes contextually relevant strategies to strengthen play-based mathematics instruction, including continuous professional development, teacher collaboration, the development of locally available teaching materials, parental involvement, and curriculum adaptation. These recommendations provide practical guidance for policymakers, school administrators, teacher educators, and classroom practitioners seeking to improve mathematics learning outcomes in Early Childhood Development programmes.

Finally, the study contributes to qualitative educational research by providing rich descriptions of teachers' experiences and perspectives, thereby complementing the predominantly quantitative literature on play-based learning and offering a deeper understanding of classroom realities in rural Zimbabwean schools.

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