

Teaching Early Mathematics in Tanzanian Preschools: Exploring Instructional Strategies in Morogoro Municipality

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ABSTRACT

This study explored the strategies implemented by preschool teachers to enhance early mathematics learning in Morogoro Municipality, Tanzania. Using a qualitative descriptive design, data were collected through semi-structured interviews with 10 preschool teachers across purposively selected schools. Thematic analysis identified six interrelated instructional strategies: play-based learning, the use of concrete and locally available materials, the integration of mathematics into everyday routines and cross-curricular activities, differentiated support for learners with varying mathematical needs, culturally and faith-grounded approaches to mathematics learning, and informal, continuous observation-based assessment. Taken together, the findings highlight the need for continuous teacher professional development in play-based, hands-on, differentiated, culturally relevant, and observation-based approaches, together with improved access to appropriate learning materials and stronger institutional support for integrating mathematics into everyday preschool activities.

Keywords: *Early mathematics skills, preschool education, instructional strategies*

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1.0 Introduction

Preschool education is considered an essential phase of development, as children are in a highly sensitive period characterized by rapid physical, cognitive, emotional, and social growth (Kumar, 2025; Melhuish et al., 2015; Roslan et al., 2022; Babakr et al., 2019). It encompasses the structured learning experiences provided to young children before they enter formal primary education. In this regard, this phase is designed to prepare children for the more rigorous demands of primary school by building foundational skills in language, mathematics, motor functions, and social interactions through a blend of guided play, storytelling, music, arts, and basic academic concepts (Shukia & Marobo, 2022; UNESCO, 2022). Furthermore, the primary objective of preschool education is to nurture a lifelong love for learning and lay the groundwork for future educational success (Kumar, 2025; Babakr et al., 2019).

In Tanzania, preschool education spans from infancy and toddlerhood in day-care centers to ages three (3) through six (6) years in pre-primary school settings (United Republic of Tanzania, 2023). Additionally, pre-primary education is provided within preschool classes hosted inside primary schools, where qualified primary school teachers are equipped to deliver the curriculum (Mgata, 2017). In this context, early education focuses on fostering cognitive, social, emotional, and physical development through a rich variety of playful and structured learning activities (Roslan et al., 2022; Babakr et al., 2019).

Early math skills comprise the foundational mathematical concepts that children acquire before beginning formal schooling (Eleftheriadi et al., 2021). These skills include abilities such as counting, number recognition, matching, classifying, comparing, ordering, spatial reasoning, understanding place value, logical observation, grouping,

and measuring. Beyond these foundational competencies, early mathematical thinking involves understanding quantities, dimensional and temporal relationships, sets, fractions, patterns, and basic unit conversions (Petropoulou et al., 2024; Eleftheriadi et al., 2021; Darnon & Fayol, 2022). Early mathematics can be broadly categorized into two main groups: numerical skills, which involve discrete quantities, and measurement skills, which involve continuous quantities. Scholars widely agree that preschool mathematics should emphasize key domains, including numbers, geometry, measurement, algebra, and pattern recognition (Petropoulou et al., 2024).

Within the number domain, children learn rote counting (reciting numbers in sequence), rational counting (assigning numbers to concrete objects), cardinal numbers (determining total quantities), and ordinal numbers (identifying position within a sequence). Similarly, in geometry, children utilize spatial language such as "up and down" or "longer and shorter" as they recognize, name, and classify shape attributes. In the measurement domain, children compare object lengths and begin using non-standard units (e.g., measuring how many shoes long an object is) to cultivate an early sense of scale and dimension (Petropoulou et al., 2024). Preschoolers also begin to grasp temporal concepts, such as "yesterday," "today," and "tomorrow." Likewise, in algebra and pattern recognition, children recreate and extend sequences, ranging from simple repeating patterns like "red, blue, red, blue" to more complex, growing numeric sequences like "2, 4, 6, 8" (Stramel, 2020).

To cultivate these developing competencies, effective instructional practices incorporate guided discussions, brainstorming, multimodal strategies, and diverse instructional materials aligned with learning objectives to enhance mathematical performance (Lavidas et al., 2022;

United Republic of Tanzania, 2023). Furthermore, creating print- and math-rich learning environments with dedicated math centers, visual displays, and posters highlighting numbers, alongside play activities like block building, significantly enhances spatial awareness, measurement capabilities, and counting skills (Eleftheriadi et al., 2021; Petropoulou et al., 2024). Additionally, incorporating hands-on manipulatives like counting objects, shape sorters, and puzzles, integrating music and movement, and sharing interactive, number-related stories engage young learners effectively. Encouraging active mathematical vocabulary (e.g., "more," "less," "big," "small") during daily interactions and asking probing questions like "How many blocks do you have?" or "Which shape is this?" further stimulates mathematical thinking. Finally, fostering problem-solving through open-ended exploration, inquiry-based tasks, and appropriate educational technologies like interactive apps and digital display boards enriches the early mathematics learning experience (Darnon & Fayol, 2022; Eleftheriadi et al., 2021).

1.2 Problem Statement

Despite global recognition of the importance of early mathematics for children's cognitive and academic success, instructional strategies for teaching early math in Tanzanian preschools remain unevenly implemented (Kambona & Ndibalema, 2025). Research indicates that numeracy instruction in Tanzanian pre-primary settings often focuses narrowly on basic counting, with teachers lacking pedagogical preparation and structured teaching strategies, which undermines the development of broader mathematical competencies among young learners (Ndijuye et al., 2020). Furthermore, studies across Tanzania reveal that many preschool teachers are not fully conversant with effective numeracy instruction and face persistent challenges, including insufficient training and large class sizes, limiting

consistent and developmentally appropriate teaching practices (Mgaiwa & Amani, 2024; Kambona & Ndibalema, 2025; Mgata, 2017).

Further evidence from national learning assessments underscores continuing concerns regarding mathematics learning outcomes in Tanzania. An analysis of the National Examinations Council of Tanzania (NECTA) Candidates’ Item Response Analysis (CIRA) reports for the Primary School Leaving Examination (PSLE) from 2012 to 2022 showed considerable variation in pupils’ mathematics performance across this period. The average pass rate was 48.7%, indicating that, on average, fewer than half of the candidates passed Mathematics during the decade under review. Although the pass rate increased from 18.74% in 2012 to 59.29% in 2022, performance remained below 60% in 2022, with 800,880 out of 1,350,784 candidates passing the Mathematics examination (National Examinations Council of Tanzania, 2022).

Table 1.1: Number of pupils who sat for Primary School Leaving Examination (PSLE) in Mathematics from 2012-2022 and their pass rate

Year	Sat for PSLE	Passed PSLE	% passed
2012	865,221	162,078	18.74
2013	844,706	241,741	28.62
2014	808,085	303,517	37.56
2015	763,493	378,502	49.58
2016	789,404	367,866	46.61
2017	909888	492, 257	54.10
2018	944,151	510,786	54.10

2019	932,136	605,588	64.97
2020	1,009,559	651,703	64.64
2021	1,107,788	638,127	57.63
2022	1,350,784	800,880	59.29
Average	938,656	515,842	48.7

Source: CIRA reports by NECTA (2012-2022)

Moreover, analysis of the CIRA reports identified Measurement, Algebra, Geometry, Statistics, and Integers among the mathematics topics repeatedly associated with poor performance, while a lack of foundational knowledge and conceptual understanding of the assessed subject matter was reported across all ten years analyzed (Kissima et al., 2024). These findings provide broader evidence of persistent challenges in mathematics learning within the Tanzanian education system. Although the PSLE assesses learners at the primary school level, these results underscore the critical importance of strengthening foundational mathematical learning from the early years, including the preschool level. Furthermore, evidence from Tanzania shows that the quality and appropriateness of early numeracy activities are often misaligned with children’s developmental levels, while parents play limited roles in reinforcing mathematical learning at home—factors that may further hinder the acquisition of early math skills (Ndijuye et al., 2020; Clements & Sarama, 2020). Although international research highlights the benefits of intentional, play-based, and equity-focused early math teaching, relatively little is known about how Tanzanian preschool teachers conceptualize, enact, and adapt instructional strategies for young learners.

Against this backdrop, the gap in empirical evidence

continues to hamper efforts to strengthen instructional quality and professional development for early mathematics teaching in Tanzania. Therefore, this study aims to examine the instructional strategies used by preschool teachers in teaching early mathematics in Morogoro Municipality, Tanzania.

1.3 Objective of the Study

- i. To examine the instructional strategies used by preschool teachers in teaching early mathematics in Morogoro municipality Tanzania.

1.4 Research Question

- i. What instructional strategies do preschool teachers use to teach early mathematics in Morogoro municipality Tanzania?

2.0 Literature Review

2.1 Instructional Strategies used by Preschool Teachers to Enhance Early Math Skills

Some researchers revealed that peer collaboration in mathematics teaching was key to helping participant teachers identify threshold concepts in mathematics that they had initially found difficult as individual teachers. This collaborative reflection functioned as a core strategy used by preschool teachers to enhance math skills for preschoolers, assisting them in teaching the subject effectively at the foundational level. Additionally, effective early mathematics instruction incorporates critical thinking, communication, collaboration, problem-solving, research-based pedagogy, problem-based learning, project-based learning, and technological integration (Henschen, 2016; Nakken et al., 2016). At the same time, Kembubi (2020) found that most pre-primary schools used physical play to

develop mathematics competencies (83.3%), followed by creative play (75.9%) and, lastly, games with rules (27.8%).

Similarly, Tachie (2022) investigated preschool teachers' mathematics strategies during remote teaching and their subsequent use of digital tools upon returning to in-person classes. The study revealed that preschool teachers prefer utilizing authentic communication frameworks that emphasize problem-solving activities to enhance all mathematical processes. Besides, Nakawa (2020) conducted a study on guided play lessons about shapes in pre-mathematics classes, examining how these lessons could be implemented and what children learned in Lusaka, Zambia. The results showed that children engaged in foundational shape activities, creating many familiar forms both in and out of school. This approach was particularly effective for explicitly teaching the basic properties of shapes and core mathematical ideas such as congruency, similarity, and symmetry. On the other hand, in Tanzania, preschoolers develop math skills through both free and guided play-based learning (Henschen, 2016; Nakken et al., 2016). The use of locally available materials, such as stones or sticks, is common for teaching math in a culturally relevant way (Mgaiwa & Amani, 2024; Kembubi, 2020), with teachers encouraging daily activities like counting and sorting using familiar objects. Additionally, technology has introduced new instructional methods, helping children explore complex concepts like symmetry and large numbers, both symbolically and practically (Sinclair, 2018; Fletcher & Ginsburg, 2016).

Despite the documented use of play-based learning, locally available materials, and technological tools to support early mathematics in Tanzanian preschools (Henschen, 2016; Nakken et al., 2016; Mgaiwa & Amani, 2024; Kembubi, 2020; Sinclair, 2018; Fletcher & Ginsburg,

2016), existing studies primarily describe which general approaches are used. They fall short of exploring teachers' underlying pedagogical reasoning, decision-making, and real-time adaptation to contextual challenges such as large class sizes, limited resources, or diverse learner abilities. Thus, little is known about how preschool teachers actually implement these strategies in practice. Furthermore, research on assessment practices and the integration of digital tools alongside hands-on, culturally relevant materials remains scarce. This gap underscores the need for empirical investigation into the instructional strategies that effectively foster early mathematics skills in Morogoro Municipality, Tanzania—insights that can directly inform teacher training, curriculum development, and educational policy.

2.2 Challenges of Early Mathematics Instruction in Sub-Saharan Africa

A growing body of literature indicates that early mathematics instruction in Sub-Saharan Africa faces multiple and interrelated challenges that hinder the development of foundational numeracy skills among young learners (UNESCO, 2022; Word Bank, 2023). For instance, evidence from international organizations such as the World Bank (2023) shows that a significant proportion of children in the region experience learning poverty, with many unable to acquire basic numeracy competencies. These challenges can be associated with inadequate teacher preparation and the limited availability of teaching and learning materials, which constrain effective mathematics instruction in early grades. Further, overcrowded classrooms, underqualified teachers as well as weak implementation of the curriculum further limits the effectiveness of early mathematics teaching, despite the presence of well-designed policy frameworks (UNESCO, 2022; Word Bank, 2023).

Empirical evidence from large-scale assessments

like RTI international (2016) also reinforces these findings through the Early Grade Mathematics Assessment (EGMA) which demonstrates that many learners struggle with basic numeracy skills such as number recognition and simple arithmetic operations. The study further indicates that instructional strategies tend to emphasize rote memorization rather than conceptual understanding, reflecting a lack of effective pedagogical approaches among teachers. Likewise, findings from the Southern and Eastern Africa Consortium for Monitoring Educational Quality (2017) reveal persistently low mathematics achievement levels across participating countries. These outcomes are linked to inadequate teacher subject knowledge and high pupil-teacher ratios, which negatively affect classroom interaction and individualized learning.

At the classroom and policy level, Melhuish et al. (2015) found that early childhood classrooms in low-income contexts often lack structured mathematics activities. Teachers predominantly rely on rote teaching methods and have limited professional training in early numeracy instruction which further supported by the United Republic of Tanzania (2023), which reports a significant gap between curriculum expectations and actual classroom strategies in pre-primary education, shortages of teaching materials and the limited use of play-based learning approaches. Further, preschool teachers largely depend on traditional “chalk-and-talk” methods, with minimal use of teaching aids or manipulatives, poor classroom environments, limited instructional time, and lack of teacher specialization in early mathematics (The African Population and Health Research Center, 2021; The Uwezo East Africa, 2019; Mgata, 2017). On the other hand, at the policy level, challenges persist in terms of resource allocation, teacher training, monitoring of learning outcomes, weak teacher preparation systems, and limited monitoring and evaluation mechanisms significantly

hinder improvements in mathematics learning outcomes (Global Partnership for Education, 2021).

Therefore, the reviewed literature demonstrates that challenges in early mathematics instruction in Sub-Saharan Africa are multifaceted, encompassing teacher-related factors, classroom strategies, resource constraints, and systemic issues. Despite increased attention to early childhood education, gaps remain between policy intentions and classroom realities, which highlights the need for context-specific and practice-oriented research to improve early mathematics teaching and learning.

2.3 Teachers' Knowledge and Beliefs as Contextual Factors in Early Mathematics Instruction

Teachers' knowledge and beliefs are important factors in shaping how early mathematics is taught in preschool settings (Ban et al., 2024). Teachers' mathematical knowledge, pedagogical knowledge, and beliefs about young children's capacity to learn mathematics can influence the instructional strategies they select and how they implement them in classroom contexts. For example, preschool teachers' knowledge of early mathematical domains, including numeracy, patterning, and spatial skills, has been associated with the frequency and nature of mathematics instruction they provide (Ban et al., 2024). Similarly, Jenßen et al. (2022) found that early childhood teachers' mathematical knowledge and beliefs develop through teacher education and professional experience, although some beliefs may persist as teachers transition from training into classroom practice. These findings suggest that teachers' knowledge and beliefs may shape the ways in which mathematical concepts are presented to young learners.

In relation to instructional strategies, teachers who

possess adequate knowledge of early mathematics may be better positioned to select developmentally appropriate approaches, such as play-based learning, guided activities, questioning, the use of concrete materials, and mathematical discussions (Hunt et al., 2024; Gqoli et al., 2022). Conversely, limited mathematical or pedagogical knowledge may constrain teachers' ability to adapt instruction to children's developmental needs. Hunt et al. (2024) reported that teachers' beliefs about early mathematics and their engagement in professional learning can influence their approaches to mathematics teaching. This indicates that professional learning may contribute not only to teachers' knowledge but also to their confidence in selecting and implementing appropriate instructional strategies.

Evidence from Sub-Saharan Africa further indicates that teachers' mathematical knowledge and beliefs can influence the nature of early mathematics instruction. Gqoli et al. (2022), for instance, found that early childhood practitioners' understanding of mathematical knowledge affected how they approached mathematics teaching, with some practitioners relying on conventional instructional approaches rather than concept-oriented strategies. Similarly, Selepe and Mphahlele (2025) reported that although teachers recognised the value of play-based learning in early mathematics, some experienced difficulties in translating these beliefs into classroom practice. This suggests that acknowledging the importance of a particular instructional strategy does not necessarily guarantee its effective implementation.

In the East African context, Opus et al. (2025) found that pre-service teachers experienced difficulties in explaining mathematical concepts and adapting instruction to learners' needs, highlighting the importance of

pedagogical content knowledge in effective mathematics teaching. In Tanzania, Ndiujye et al. (2020) similarly highlighted concerns regarding the status and development of early childhood education, including challenges associated with teachers' preparedness and classroom strategies. Mgaiwa and Amani (2024) further reported challenges related to teachers' beliefs and instructional strategies in Tanzanian early childhood education. Together, these findings suggest that teachers' knowledge, beliefs, and professional experiences constitute important contextual factors that may shape the instructional strategies used in early mathematics classrooms.

However, much of the existing literature has focused on teachers' knowledge, beliefs, or general challenges in early mathematics instruction, with comparatively limited attention to how preschool teachers in Tanzania describe the specific instructional strategies they use in their everyday teaching. Understanding these strategies is important because teachers may adapt their approaches according to their knowledge, beliefs, available resources, learner characteristics, and classroom contexts. Therefore, examining the instructional strategies reported by preschool teachers in Morogoro municipality can provide context-specific evidence on how early mathematics is approached in Tanzanian preschools. This perspective directly supports the present study's objective of examining the instructional strategies used by preschool teachers in teaching early mathematics.

2.4 Theoretical Framework

This study is underpinned by Bruner's Theory of Representation, which explains how learners construct and represent knowledge through three complementary modes: enactive, iconic, and symbolic representation (Bruner,

1974). The theory emerged from Bruner's broader constructivist perspective on learning, which views learners as active participants in constructing knowledge through interaction with their environment. The theory assumes that learning can progress from direct manipulation and action (enactive), through visual and image-based representations (iconic), to abstract symbols and language (symbolic). These modes are complementary rather than strictly sequential, allowing learners to revisit concepts through different forms of representation as their understanding develops (Bruner, 1974).

The theory has been applied to explain how children develop conceptual understanding when learning abstract concepts through concrete experiences, visual representations, and symbolic forms. In early mathematics, this perspective is particularly relevant because young children can develop mathematical concepts through manipulating concrete objects, observing visual representations, and gradually connecting these experiences to mathematical symbols and language (Lavidas et al., 2022). Thus, the theory provides an appropriate lens for understanding the instructional strategies used by preschool teachers in teaching early mathematics.

In the present study, Bruner's Theory of Representation guides the interpretation of teachers' reported use of play-based activities, locally available concrete materials, visual resources, and other activity-based approaches in early mathematics instruction. The theory therefore helps explain how teachers support preschool children in moving from concrete experiences towards increasingly abstract mathematical understanding.

3.0 Methodology

3.1 Research Design

This study implemented a qualitative descriptive research design to examine the instructional strategies used by preschool teachers in teaching early mathematics in Morogoro municipality, Tanzania. A qualitative approach was appropriate since the study sought to gain in-depth insights into teachers' reported instructional strategies. Data were collected through semi-structured interviews, allowing participants to describe the strategies they use, the rationale behind their choices, and the contextual factors influencing their instructional decisions. This design enabled a rich, detailed understanding of early mathematics teaching strategies from the teachers' perspectives.

3.2 Sampling Techniques and Sample Size

A non-probability sampling approach, specifically purposive sampling, was used to select participants who met the study's inclusion criteria. Ten (10) preschools offering pre-primary education in Morogoro municipality were purposively selected to ensure representation of the study context. One preschool teacher was then purposively selected from each participating school, resulting in a total sample of ten (10) preschool teachers. Participants were selected based on their direct experience in teaching early mathematics and their relevance to the study objectives. The sample size was considered adequate because the participants possessed direct and relevant experience in teaching early mathematics, and the interviews generated sufficiently rich information to address the research question.

3.3 Criteria for Selecting Sample

The study involved preschool teachers from both public and private school in Morogoro municipality Tanzania who were selected based on specific characteristics

relevant to the research objectives. This selection allowed for the exploration of instructional strategies across different school settings. The participating teachers had a minimum of two years of teaching experience and varied in educational qualifications, ranging from certificate to degree level. Their ages ranged from 21 to 60 years, and both male and female teachers were included to ensure diverse perspectives. These characteristics were considered appropriate as they represent the target group for early mathematics learning.

3.4 Trustworthiness of the Qualitative Data

Trustworthiness of the qualitative data was ensured through credibility, transferability, dependability, and confirmability (Ahmed, 2024). A pilot study was conducted with five preschool teachers who were not included in the main study. The pilot was undertaken to assess the clarity, relevance, sequence, and comprehensibility of the semi-structured interview questions and to identify areas requiring refinement before the main data collection. The pilot participants were selected because they shared characteristics similar to those of the target participants. Feedback from the pilot informed minor revisions to the interview guide and interviewing procedures. Credibility was achieved through semi-structured interviews and member checking, where selected participants verified the accuracy of the data. Transferability was ensured through thick description of the study context and participants. Dependability was maintained by keeping an audit trail of the research process, while confirmability was ensured through grounding findings in participants' responses and peer debriefing with research experts.

3.5 Data Collection Process

Data were collected through face-to-face semi-structured interviews with ten (10) preschool teachers from

the selected public and private schools in Morogoro municipality. The interviews were conducted by the researcher at the respective participating schools in a quiet and suitable setting that allowed participants to express their experiences freely and without interruption. Before each interview, the researcher explained the purpose of the study, the interview procedures, and participants' rights, and informed consent was obtained. The researcher conducted all interviews using a semi-structured interview guide developed in line with the study objective and research question. The interviews focused on the instructional strategies teachers used in teaching early mathematics, including the activities, materials, approaches, and classroom strategies they reported using with preschool children. Probing questions were used where necessary to obtain clarification and explore participants' responses in greater depth.

With participants' permission, all interviews were audio-recorded to ensure accurate capture of their responses. The interviews were conducted in Kiswahili to enable participants to express their experiences comfortably and accurately. Each interview lasted approximately 45 minutes. Data collection was conducted over a period of ten days. Following data collection, the audio-recorded interviews were transcribed verbatim in Kiswahili and subsequently translated into English for analysis. The researcher reviewed the transcripts against the audio recordings to ensure accuracy and completeness before proceeding with thematic analysis.

3.6 Data Analysis Procedures

The interview data were analysed thematically using ATLAS.ti through a combined inductive and deductive thematic analysis approach. The use of a hybrid approach

was considered appropriate because the analysis was informed both by concepts identified from the study objective, relevant literature, and Bruner's Theory of Representation, while also allowing patterns and meanings to emerge from participants' accounts.

First, the raw interview data collected in Kiswahili were transcribed and translated into English. The researcher then read and re-read the transcripts to become familiar with the data and to identify content relevant to the study objective. The deductive component of the analysis was guided by concepts identified from the literature on early mathematics instruction and the theoretical orientation of the study. These included, among others, play-based learning, the use of concrete materials, and integration of mathematics into everyday activities, differentiated instruction, as well as assessment practices. These concepts provided an initial analytical direction but were not treated as fixed themes.

Second, an inductive coding process was undertaken to allow codes and patterns to emerge from the teachers' responses. Meaningful segments of text were identified and assigned initial codes that captured the ideas expressed by participants. For example, teachers' descriptions of counting, sorting, matching shapes, and learning through games were coded as forms of play-based mathematical learning. Similarly, descriptions of using stones, sticks, bottle tops, fruits, and classroom furniture generated codes related to hands-on and locally available materials.

Third, related codes were compared and clustered according to conceptual similarity to develop sub-themes or categories. During this process, the researcher remained open to patterns that were not predetermined by the literature or theoretical framework. The sub-themes were subsequently reviewed, compared, and refined to identify

broader patterns across participants' accounts.

Finally, the inductive and deductive insights were integrated to develop broader analytical themes that captured both the established conceptual areas and the meanings emerging from the participants' experiences. For example, the initial concept of play-based learning was further interpreted from the participants' accounts as "play-based learning as a bridge between active experience and mathematical understanding." Similarly, teachers' descriptions of using stones, sticks, and bottle tops informed the broader theme "improvisation of familiar materials to make abstract mathematical concepts concrete." Thus, the final themes were not simply descriptive labels but represented patterns and interpretations developed through interaction between the existing conceptual framework and the empirical data.

Throughout the analysis, analytic memos were maintained in ATLAS.ti to document coding decisions, emerging interpretations, relationships among codes and categories, and the development and refinement of themes. The final analytical framework therefore consisted of themes, sub-themes/categories, codes, illustrative quotations, and analytic memos, which guided the presentation and interpretation of the findings.

3.7 Ethical Issues

For ethical considerations, the researcher got a letter of permission for data collection from the office of the Director of Postgraduate Studies, form International Islamic University Malaysia. One letter introduced the researcher to the District Executive Director attached with the letter from the university which the researcher implemented to introduce her to the District Executive Director. Then, the researcher allowed to collect the data to the targeted schools after the school head teachers being informed by the District

Executive Director. Informed consent was obtained from all participants and confidentiality was maintained throughout the research process. Personal identifiers was removed from data to ensure that individual responses cannot be traced back to specific participants. Data were securely stored and only accessible to the researcher.

4.0 FINDINGS

4.1 Profile of the Respondents Involved in Data Collection

Respondents' Information	Category	Frequency
Age group	Age group	04
	High age group-21-60	06
Working Experience	Experienced (≥ 15)	02
	Less Experienced (≤ 15)	08
Education Qualifications	Certificate	02
	Diploma	03
	Bachelor degree	05
	Master degree	00

Source: Field data, December, 2025

Table 4.1 indicates that many participants involved in the study had high age group between 21-60 years, work experience between 15 years and above. Also, most of them had bachelor degree of education qualifications.

4.2 The instructional strategies used by preschool teachers in teaching early mathematics in Morogoro municipality, Tanzania.

Theme	Sub-theme/category	Code	Example quote	Memo
Play-based learning as a bridge between active experience and mathematical understanding	Play based learning	Play-based mathematical learning	"Children learn through games such as sorting objects, matching shape and counting using bottle tops, stones, or sticks."	Play-based methods enhance engagement and understanding of mathematical concepts.
Improvisation of familiar materials to make abstract mathematical concepts concrete	Use of concrete and locally available materials	Hands on materials	"We use locally available materials such as stones sticks, bottle tops, number cards, fruits, and classroom furniture."	Tactile learning is crucial materials are often improvised and culturally relevant.
Embedding mathematics in everyday routines and cross-curricular experiences	Integration into daily activities	Math integration	"We account children during attendance, use stories with number in language lessons, compare objects in science, and draw shapes in art."	Math is embedded across subjects and daily routines, not taught in isolation.
Connecting mathematical learning with children's cultural and faith-based experiences	Cultural & Faith-based practices	Culturally relevant mathematics	"We incorporate local songs examples from the market and Bible stories with numbers...this helps children relate math or their lives."	Connecting math to culture and faith enhances relevance and motivation.
Adapting instruction to respond to differences in children's mathematical learning needs	Differentiated instruction	Differentiated support	"Children who struggle receive extra attention, small-group support, repetition and praise. We avoid pressure and repeat activities until they gain confidence".	Differentiated support and positive reinforcement critical for struggling learners
Using continuous observation to identify and respond to children's mathematical understanding	Informal & continuous Assessment	Observation based Assessment	"Assessment is mostly informal, we observe children during play, group work and daily activities. Tasks completed independently indicate understanding."	Emphasis on observation over formal written tests, supports child-centered evaluation.

4.1. Play Based Learning

Thus, in table 4.2 above shows that teachers use play based learning like sorting objects, matching shapes, and counting using bottle, tops, stones, or sticks . In reference to this, one teacher stated "*children learn through games such as sorting objects, matching shapes and counting using bottle tops, stones or sticks*" (T2 Semi-Structured Interview SSI, 2026). Play - based learning is an effective strategy for preschool children as it promotes engagement and active participation. It also supports the development of mathematical concepts through exploration and hand-on experiences. This approaches is particularly useful in early childhood settings where children learn best through play.

a. The Use of Concrete and Locally Available Materials

Furthermore, the findings show that teachers rely on the use of locally available materials such as stones, sticks, bottle, tops, number cards and fruits as one among the teachers explained that "*We use locally available materials such as stones, sticks bottle tops, number cards, fruits and classroom furniture's*" (T8 SSI, 2026). The use of concrete material supports the development of concrete thinking which is crucial for preschool children. Since young learners are still developing abstract reasoning concrete objects help them visualize and understand mathematical concepts. The use of local materials also demonstrates teacher's adaptability and resourcefulness in context with limited resources.

4.3. The Integration of Math skills into Daily Activities

Teachers embed mathematics across different activities such as attendance counting, storytelling with numbers, science comparisons and art activities involving shapes. One teacher remarked explanation from one teacher is "*We count children during attendance, use stories with numbers in Mathematics lessons compare objects in science and draw shapes in art*" (T6 SSI, 2026).Integrating mathematics

across subjects promotes a holistic approach to learning. This strategy enables children to see mathematics as obvious of their fairly experiences rather than a separate subject. It also supports the development of numeracy skills through repeated exposure in various contexts.

4.4. Cultural and Faith-Based Practices

In cultural and Faith-Based Practices, some teachers incorporate local songs, market examples, and Bible stories containing numbers to teach mathematics. A teacher noted that *"We incorporate local songs, examples from the market and Bible stories with numbers.... this helps children relate math to their lives"* (T8 SSI, 2026). Cultural and faith - based practices make learning more relevant and meaningful By connecting mathematical concepts to local culture and faith teachers enhance children's motivation and engagement. This approach also supports the development of cultural identity and values alongside academic skills.

4.5. Differentiated Instructions

Teachers provide additional support to learners who struggle with mathematics. Strategies include small- group support repetition, praise and avoiding pressure. A teacher stated, *"Children who struggle receive extra attention, and praise"* (T4 SSI, 2026). Differentiated support is essential in early childhood education as children have varying learning abilities. The use of positive reinforcement and repetition helps struggling Learners build confidence and gradually improve their mathematical skills.

4.6. Informal and Continuous Assessment

The data show that assessment in early mathematics is mostly informal and continuous. Teachers observe children during play, group work, and fairly activities to determine their understanding. One teacher said *"Assessment is mostly*

informal; we observe children during play, group work, and daily activities" (T9 SSI, 2026). Informal assessment is appropriate for preschool settings it allows teachers to monitor children's learning without causing anxiety. Observation based assessment also supports a child centered approach focusing on the child's progress and developmental readiness rather than formal tests.

5.0 Discussion

The findings of this study report that preschool teachers in Morogoro municipality, Tanzania implement a range of contextually relevant instructional strategies, including play-based learning, the use of concrete and locally available materials, integration of mathematics into everyday routines and cross-curricular activities, differentiated support, culturally and faith-based practices, and informal and continuous assessment. Teachers reported using activities such as counting, sorting, and shape recognition with objects like stones, sticks, and bottle tops, which support concrete understanding and the transition to abstract reasoning (Mgaiwa & Amani, 2024; Kembubi, 2020). Peer collaboration among teachers was also highlighted as crucial for identifying threshold concepts and improving instructional effectiveness, aligning with prior research on collaborative professional learning (Tachie, 2022; Roslan, 2022). Guided play approaches, including lessons on shapes, promote understanding of geometric concepts such as congruency, similarity, and symmetry (Nakawa, 2020), while integration of mathematics into daily routines fosters repeated exposure and contextual learning (Henschen, 2016; Nakken et al., 2016). Additionally, teachers utilize research-based strategies, problem-based learning, project-based learning, and technological tools to support critical thinking, problem-solving, and engagement (Sinclair, 2018; Fletcher & Ginsburg, 2016; Tachie, 2022). Generally, these strategies demonstrate a holistic, culturally relevant, and

developmentally appropriate approach to early mathematics instruction, emphasizing teacher adaptability, resourcefulness, and the importance of professional collaboration to enhance learning outcomes for young children.

6.0 Recommendations

Based on the findings, the study recommends targeted professional development to strengthen teachers' use of play-based, hands-on, differentiated, and culturally relevant approaches to early mathematics instruction. Moreover, schools and education authorities should facilitate access to locally available and developmentally appropriate learning materials and support teachers in improvising safe, affordable resources. At the same time, teachers should also integrate mathematics into daily routines, storytelling, songs, art, and other classroom activities to provide meaningful opportunities for mathematical learning. Furthermore, teachers should use differentiated support and continuous observation-based assessment to identify learning difficulties, monitor children's progress, and adapt instruction accordingly. Thus to say, professional support should focus on strengthening practices already demonstrated by teachers, particularly play-based learning, concrete materials, contextualized instruction, differentiated support, and formative assessment.

7.0 Conclusion

Thus to say, preschool teachers in Morogoro municipality, Tanzania implement a diverse and contextually relevant set of strategies to enhance early mathematics skills including play-based learning, use of concrete materials, guided activities, integration of numeracy across daily routines, differentiated instruction, peer collaboration, and technology-supported pedagogy which contributes to

effective early mathematics instruction. Similarly, teachers' adaptability, creativity, and collaborative practices are critical for addressing resource constraints and supporting children's mathematical development. These findings underscore the importance of ongoing professional development, access to appropriate teaching materials, and support for teacher collaboration to strengthen early mathematics education in preschool settings.

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COMPETING INTERESTS

The authors declare that no competing interests exist.

AUTHORS' CONTRIBUTIONS

Abla Shaffy (corresponding author) designed the study, conducted the data collection and analysis, and wrote the first draft of the manuscript. Dr. Hasniza Ibrahim (co-other) provided guidance on study design, reviewed and edited the manuscript, and contributed to the interpretation of results. All authors read and approved the final manuscript.

ETHICAL APPROVAL

This study was conducted in accordance with ethical standards for research involving human participants in educational settings. Ethical approval was obtained from International Islamic University Malaysia (IIUM). Participation was voluntary, and informed consent was obtained from all participants.

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