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Exploring Practitioners' Lived Mathematical Play Practices in the Early Childhood Care and Education Setting

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Abstract

Attention to engaging children in math-related play is increasing, but how early childhood practitioners in South Africa practice lived mathematical play is unclear. This study sought to determine early childhood care and education practitioners' lived mathematical play practices. The study was anchored on Vygotsky's social constructivist theory, which holds that children learn best when scaffolded and mediated by people with more knowledge than they do. The study adopted a phenomenological research design using a sample of 10 practitioners. The researchers gathered data using a semi-structured interview guide. A thematic analysis was used to analyze the data that were gathered. The study's findings revealed that early childhood partitioners' lived mathematical play practices include building relationships, showing respect, having passion, being experienced, and acting in loco parentis. Moreover, practitioners know and understand what is expected of them in ECCE, particularly regarding the teaching of mathematical play-based learning. It was recommended that practitioners' lived mathematics play-based learning be improved through appropriate teacher development programs and by gaining acceptable qualifications.

Keywords: *Early childhood care and education; early childhood development; mathematical play; practitioner*

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A. INTRODUCTION

Experiences of the researchers in early childhood care and education (ECCE) have shown that there has been increasing attention paid to the quality of teaching and learning of young children. This increasing concern relates to the need for practitioners who can comprehend what is happening in the ECCE setting and know how to engage children in early mathematics-related play through innovative approaches compatible with the ECCE setting (Svensson, 2015). Young children find mathematical play noisy, messy, fun, and interesting, and, at the same time, it inspires growth and intellectual development in language, literacy, logic, and mathematics in the ECCE setting (Trundle & Smith, 2017). To enhance these skills in children, practitioners should create opportunities to explore and practice mathematical play, as children spend much time in ECCE centers, which become the social environment where learning occurs (Sotuku et al., 2016). These opportunities are rarely provided to young children in South Africa, as ECCE practitioners often neglect them and offer what feels comfortable in the ECCE setting (Helmbold, 2014). Ashley-Cooper et al. (2019) added that there is no equitable access to ECD provisioning in South Africa, which impedes the overall development of the children in such centers. Our experience as researchers has taught us that high-quality teaching and learning in mathematics occurs through play. Thus, play creates more opportunities for young children to learn and have quality access in the ECCE setting. However, prior to this work, it was unclear what lived mathematical play practices of the ECCE practitioners are in the South African context.

Although the play is an important vehicle for promoting teaching and learning in the early years, particularly in ECCE mathematics, it would appear that practitioners are not realizing and practicing it enough. Practitioners are often unaware that play can support academic and social learning and their roles in children's play (Vu et al., 2015). Considering the South African context, there is a long way to go to improve the quality of teaching and learning in the ECCE setting. Practitioners still struggle to conceptualize the ECCE setting and understand mathematical play programs that children need to be exposed to. ECCE mathematics education requires a distinctive and child-friendly approach. Studies have shown that there are specific characteristics associated with ECCE mathematics education. For instance, Beke (2017) asserts that, through mathematics education, children begin to know the world around them and realize it through concrete actions, interaction with others, and problem-solving. In addition, mathematics education in early childhood has long-term positive effects on future academic success and access to the labor market for children at a later stage (Lebihan & Moa Takongmo, 2018).

Furthermore, a solid foundation for mathematics literacy fosters young children emotionally, socially, intellectually, physically, spiritually, and morally (Nel, 2019). Palmér et al. (2016) argue that young children demonstrate a remarkable ability to formulate, represent, and solve simple mathematics problems and reason and explain their mathematics activities in their first mathematics encounter. According to Moss et al. (2016), mathematics education builds prior knowledge in the child. However, this alone is not enough to develop mathematical thinking – the child also needs guidance from an adult. Askew and Venkat

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(2020) believe that one of the aims of mathematics education is to provide children with the skill of being fluent in early counting and developing an appreciation of numerosity.

Given these distinctive attributes of mathematics education in the ECCE setting, practitioners must follow a unique approach that revolves around how children learn in the ECCE setting. The approach to learning mathematics should be based on integration and play-based learning. Practitioners play a significant role in advocating for appropriate practices to stimulate mathematical concepts; among these practices are purposeful play, child-directed play, scaffolding, and mediation that follow children's intuition in the ECCE setting (Feza, 2016).

In the South African context, play is regarded as children's right. It allows children to rest, have leisure, play, participate in recreational activities appropriate for their ages, and engage freely in cultural life and the arts (Abrahams & Matthews, 2011). Bezuidenhout, Henning, Fitzpatrick, and Ragpot (2019) argue that many South African children fail to develop an understanding of mathematical concepts that are required for Grade 1. Setoromo and Hadebe-Ndlovu (2020) opine that teachers of young children are expected to offer a mathematics education that exposes children to deep and explicit high-level mathematical knowledge and prepares them for learning in the formal environment. This practice will assist children in developing mental processes that enhance logical and critical thinking, accuracy, and problem-solving, which will, in turn, contribute to decision-making, particularly in mathematics education.

Furthermore, the mathematics teaching approach should be based on the principle of integration and play-based learning. Thus, such an approach should include all learners, regardless of socioeconomic status, background, race, gender, or physical ability. It will enable them to achieve self-fulfillment and meaningful participation in society as citizens of the country. This statement advances the commitment of the Education for All policy, which was launched at the World Conference in 1990 and taken up by several countries worldwide. The first goal of this policy is to expand ECCE and improve every aspect of education (Madani, 2019). However, research in South Africa is not clear on the status of practitioners' lived mathematical play practices, which are germane in realizing the ECCE policy statement. This gap in literature necessitated this research on the lived mathematical play practices.

A study conducted by Pyle et al. (2018) reveals that children's play occupies an important role in the ECCE setting, and the role of the teacher is vital for nurturing children's early personal and social development through learner-centered activities that will assist children in constructing new ideas. Pyle (2018) states that play is often thought to be the primary occupation of children, and its potential for learning and development has been explored in research for decades. Scholars declare that play is a natural activity of human beings, mainly during the first years of life, and it acquires key, relevant elements from a pedagogical point of view at the level of ECE (Bastías et al., 2021). Trawick-Smith et al. (2017) showed that using block play boosted social participation and the percentage of mathematical structures developed. Findings revealed that when teacher candidates could

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participate in play-based learning activities that included mathematical concepts, self-efficacy, and subject knowledge improved (Cohrssen & Tayler, 2016).

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

Lee et al. (2020) argue that teachers should create a playful environment where children will enjoy and participate fully in meaningful mathematical play activities to know and understand play or play-based learning. This engagement will enrich children's natural interest in play-based learning and trigger their curiosity and imagination, as this forms part of learning in the ECCE setting. Reikerås (2020) postulates that high-quality work with mathematics in the ECCE setting is essential, especially for children with a weak foundation in mathematics, and, as a result, teachers should focus on play-based mathematics to enhance children's skills. However, adult engagement in play-based learning has an important role in determining the mathematics learning outcome of children. Examples of activities are parents guiding their children to make correct measurements when they cook together and asking the child to count the number of forks needed for a family dinner.

Furthermore, identifying the shapes of signs when riding in a vehicle could be a good strategy for mediating play-based mathematics at home (Ramani & Scalise, 2020). Farrugia (2021) discovered another type of play that leads to the development of mathematical play concepts, called play with loose parts, which involves a set of items like pebbles, acorns, shells, tree slices, corks, ice-cream sticks and blocks, which could amuse children while developing their mathematics skills while they are playing. Lee et al. (2020) suggest that, in order to engage in new and inclusive mathematics practices, it is important to understand how to use play's unique ability to engage children in boundary testing as a meaning-making activity that is central to participating in mathematical play practices in the ECCE setting. It implies that young children's mathematics education can be undertaken through play, which can be mediated by using different types of toys and self-made teaching and learning materials and by allowing children to initiate play-based mathematics. Intergrade teaching and learning moments should be gradually introduced during the interaction between the practitioner and the child, considering the child's context. Blending mathematics and play for

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learning in the ECCE setting gives children joy and amusement, which is important for promoting lifelong learning.

Available literature indicates that research is scarce in the South African context with respect to practitioners' lived mathematical play practices in ECCE. This has created a gap in the literature, which the researchers sought to fill. Thus, the primary purpose of this research was to explore practitioners' lived mathematical play practices in the early childhood care and education setting. Consequently, the research question pursued was: What are practitioners' lived mathematical play practices in an ECCE setting?

B. METHOD

Research Paradigm

In this study, an interpretivism research paradigm was adopted as it fits well with the research approach that was chosen for the study. Interpretivism research paradigm is used in a context where researchers cannot presume direct access to reality since reality is socially constructed and subjective. It is frequently employed in social science research to comprehend how individuals understand and provide meaning to their experiences. Thus, the adoption in this research sought the practitioners' lived mathematical play practices in the early childhood care and education setting. Interpretivists believe that the social world can only be understood from the standpoint of the individuals participating in the investigated phenomenon.

Research Approach

In this study, we employed a qualitative research approach. This approach was used because it focuses on lived experiences in their natural setting, preserves the chronological flow, and documents the events that lead to consequences (Tracy, 2019). According to Nardi (2018), investigating lived experiences refers to trying to understand events from the viewpoints of the people who are part of the events and to understand their experiences instead of imposing another person's viewpoint. The qualitative approach was relevant to the study because it provided the researcher with rich data collected during the fieldwork, giving insight into human behavior in its social context (Devlin, 2018).

Design of the Study

This study adopted a phenomenological research design. A phenomenological research design is a qualitative research technique that examines how individuals perceive a phenomenon. Using phenomenology allowed us to determine the practitioners' lived mathematical play practices in the early childhood care and education setting. This design has been adopted by Gqoli et al. (2021) and Gqoli et al. (2023).

Research Site

In the Free State, this study focused on the Motheo District, part of the Mangaung Municipality. This district has several cities, including Bloemfontein, Mangaung, Botshabelo, Dewetsdorp, Ladybrand, and Botshabelo. As part of this study, we focused on the five Mangaung CBCs registered with the DSD and owned by the community.

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There were three centers located in Mangaung township in three selected informal settlements. In each informal settlement, we focused on no more than two centers. The ECCE setting is typically associated with disadvantaged communities, directly impacting practitioners' mathematical play practices.

Participant Selection

The study sample comprised ten females with matric certificate qualifications and at least three years of experience working in the ECCE setting. Purposeful sampling was used to select the participants for the study. Purposeful sampling is often used for a small-scale sample data collection process and is suitable for studies that involve an in-depth study of human experience (Leavy, 2017; Maree & Pietersen, 2019). Participants were selected on purpose to represent a group because they were able to provide the relevant information for the study. We selected five participants who had experience coaching children who were three years old, and another five were selected because they had experience teaching four-year-old children. The participants we selected were female because, historically, caregiving in the ECCE setting is an occupation for women. Based on A's assertion that many games are sites for the production of contemporary masculinity, it was decided to select female practitioners since they both demand and appear to ensure performances, including heroism, killing, winning, competition, and action, coupled with technological skill and rationality, as well as heroism, killing, winning, competition. It is also important to note that A recognized that the games created possibilities for bodies, affectivities, discursivity, and practice using an anti-essentialist argument. A argued that contemporary femininity requires practices and performances that combine heroism, rationality, and sensitivity while maintaining a sense of care, cooperation, and concern.

Instruments for Data Collection

A semi-structured interview schedule was used for data collection. Since this research was qualitative, we observed participants closely to find out what they did, how they did it, and what instructions were given verbally or non-verbally to children. Interviews because they are suitable for gathering information in more complex situations, helpful in collecting in-depth information, and have broad application. In interviews, information was supplemented, and questions were explained (Kumar, 2019). Semi-structured interviews were conducted for the study. Semi-structured interviews allowed us to interact face-to-face with the participants, ask them questions, and record all the information for analysis. Our choice for this method was to allow the participants to choose any questions they felt comfortable responding to. We also had the opportunity to formulate questions as issues were raised at the spur of the moment. We used discussion to explore and probe for more information where necessary. We allowed the participants to ask questions where they needed clarity. Additionally, we clarified the meaning of questions, uncovered practitioners' lived practices, and gathered any information necessary to achieve the aim and objectives of the study.

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Data Collection Procedures

In the study, we used interviews as a tool for data collection. We employed face-to-face, semi-structured interviews. During the process of interviews in this study, we interviewed 10 selected practitioners from five selected CBCs in three selected informal settlements in Mangaung township. In each of those five community-based centers, we interviewed two practitioners, one responsible for three-year-old children and another one responsible for four-year-old children. Since data in qualitative research is collected through a set of predetermined questions relating to the inquiry issue, we developed an interview protocol to ensure the desired coverage of the areas of inquiry and comparability of information across participants (Kumar, 2019). Although flexibility was maintained regarding follow-up questions and the sequence in which questions were asked, the interview guide with predetermined questions was used to ensure the smooth running of the interview process (Roulston & Choi, 2018). It allowed us to remain balanced and flexible during the interviews, explore the phenomenon in question holistically, and obtain answers from the participants.

Data Analysis Procedures

Data processing, analysis, and interpretation took place after data had been gathered. We analyzed the data using thematic analysis methods. The transcription, which included verbal and non-verbal cues during the interviews, was carefully considered. Thereafter, we took time to reread the text and listen to the audio and visual recordings repeatedly while considering the aim and objectives of the study. We read through the transcription and contents of the journal used during the data collection process and reflected on the important and interesting points we had identified during data collection.

Ethical Considerations

The first ethical issue we considered was completing the necessary research ethics clearance in application forms, through which we obtained permission to conduct the study from the University of the Free State. Secondly, we applied for permission from DSD, which was granted. To start with data collection at the selected CBCs, we requested permission from the principals or the center managers before interacting with the practitioners in the ECCE setting. During the briefing sessions, we explained the necessity for informed consent to participants before various parties signed and the data collection process commenced. As a key principle of social research ethics, prospective research participants were given information as required to make an informed decision about whether they wished to participate in the study (Patten & Newhart, 2018).

C. RESULT AND DISCUSSION

1. Result

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

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

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

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

This sub-theme explores the specific mathematical play practices practitioners must implement in the ECCE setting. Participants highlighted essential qualities and skills, such as communication, passion, and fostering a loving environment, as foundational to their practices. Participants made the following utterances during semi-structured interviews:

P2: *A teacher working in the ECCE is expected to have strong communication skill as young children do not always express themselves or communicate what they feel or want. Again, you should build relationships and exercise respect as children are very perceptive, they act or respond according to how they are being treated.*

P3 & P5: *The practices that are expected from me as a practitioner, I'm expected be passionate about children, to love and play with them, to enjoy everything that I would do with them because working with children here, I worked with adults, we have to give them love. As a practitioner in the ECCE, you must take care of the children, because most of the children who come to crèche, are expecting love from us as their practitioner because sometimes they do not always get love at home or from their parents.*

P4: *I would say the kind of practices from what I would say is more experience in a practitioner. Having to teach a child math you must have experience and you must have the love for a child.*

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

This sub-theme explores the specific mathematical play practices that involve full participation by all children. Thus, some of the practices that are expected of practitioners to ensure that children participate fully in mathematical play-based learning activities are play and vast mathematical experience in childcare. The participants commented as follows:

P1*: Through play, children learn to know each other and the work they are doing. This will then give children an opportunity to understand the mathematical language, which is first, second, third and fourth. They can also count how many are red, white, black, how many are circles, square, etc.*

P4: *I would say the kind of practices from what I would say is more experience in a practitioner in maths. Basically, you must have love for children, you must be a parent to them in the centre.*

P6: *I expect that when we are teaching anything, we will start with concrete object before we go to abstract in teaching. We always start concrete and with their own bodies, and they have to experience the things for themselves to be able to know something.*

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

This sub-theme explores the specific inspirational mathematics play-based learning to help children construct new knowledge which include creating curiosity, making fun of the learning activities, using puzzles, using building blocks among others. The following utterances by the practitioners responded to sub-theme 1.3:

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

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

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

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

This sub-theme explores the advocacy for stimulating, scaffolding, and mediating play-based mathematics. Thus, the specific advocacy for stimulating, scaffolding, and mediating play-based mathematics includes creating a mathematical experience, and allowing the pupils to walk around the classroom.

The above statement was confirmed by participants' responses:

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

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

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

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

This sub-theme explored the importance of planning developmentally appropriate play-based learning. It was found that planning developmentally appropriate play-based learning includes considering the pupils' developmental ages, knowing their needs, and

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observing individual differences among the pupils. They reported the following ways of and reasons for planning to engage children in mathematical play-based learning:

P1: *Yes, we plan according to their developmental ages. Then we will look at the planning, which ones are good for that level of development.*

P7: *I will say yes mam. My reasons are if you do not plan, as a practitioner, you will not notice what the needs of your children are. You will not be able to also improve your work or the way you are teaching. These developmentally appropriate practice are communication skills, develop key language and communication development of motor skills, holistic develop that include social and emotional development.*

P9: *I plan and then I would go through my planning and consider each and every child in the class and how it will affect them and what I can do to explain it better to that certain child. Because you know your children and you know how they learn.*

P1, P7, and P9 statements indicate how each practitioner plans for developmentally appropriate activities. All three of them pointed out that, through planning, they can see which activities are relevant for a particular age group.

2. Discussion

The findings of this research have shown that practitioners who work with children should build relationships, show respect, have passion, be experienced, and act in loco parentis. Practitioners know and understand what is expected of them in ECCE, particularly regarding the teaching of mathematical play-based learning. They believed they possessed these qualities and applied them in their interaction with young children. Children need more attention, and practitioners act as the first parents that children interact with outside their family circle. Hence, participants believed they should assume and execute parental responsibilities as they interact with children daily in the ECCE setting. During the interview sessions, when we discussed practitioners' lived mathematical play practices in the ECCE setting, showing love, care, and respect was the most important practice expected of a teacher working in this environment. Through their focus on showing care and support, we noticed they are passionate about their work and children. However, they lacked support and guidance on how to nurture children and playfully enhance their numeracy skills. Mathematical play was another focal point that was mentioned often. However, few practitioners could display and demonstrate how to engage children in such a way that children participated in all mathematics activities. In doing so, practitioners followed a daily program, which we found only in two CBCs, while other centers did the activities they wanted to teach on a particular day. The NCF indicates that practitioners or caregivers in the ECCE setting should follow effective practices that have been planned and integrated according to what is best for children's holistic development (DSD, 2015).

In some instances, we realized that few practitioners contextualized what should happen in the ECCE setting. They spent most of the time ensuring that children aged three and four could write or trace properly on pictures and numbers. Some practitioners were expecting three-year-old children to write their names on pages. They seemed to

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have forgotten that writing development does not happen at that age and that children should pass through several stages of writing skill development before they can write mathematical concepts and symbols. It was also noted that scaffolding and mediation play a significant role in mathematical play-based learning. Mediation during mathematical play-based learning assists children in performing tasks under the guidance of their practitioner so that they learn how to do the task alone. Scaffolding is a good strategy and was implemented by practitioners to ensure that all children participated in mathematical play. At the same time, the knower assists children struggling with the task to catch up with their peers. Once the children could work on the task, this assistance was gradually withdrawn so that they could work hands-on to execute the assigned tasks. This type of learning is labeled as child-directed learning or activity, as the children can take the lead in their mathematics learning. In line with the findings, Trawick-Smith et al. (2017) showed that using block play boosted social participation and the percentage of mathematical structures developed. Findings revealed that when teacher candidates could participate in play-based learning activities that included mathematical concepts, self-efficacy, and subject knowledge improved (Cohrssen & Tayler, 2016).

Buttressing these findings further, Edwards (2017) found that child-oriented play may be a promising, effective, and inexpensive means of promoting positive development for preschool children. Shimpi et al. (2014) investigated Chinese trainee ECE educators' perceptions of Western-style, child-centered ECE praxis in China. They found that beliefs and perceptions about children's learning can affect their learning outcomes. Therefore, teachers are encouraged to follow the interests of and actively engage in activities alongside children (Shimpi et al., 2015). A study in Ghana by Kekesi et al. (2019) found that early childhood teachers in Afadjato South District had positive perceptions about the use of play as a teaching technique and its positive influence on children's learning. In Malaysia, Puteh (2013) investigated preschool teachers' perceptions regarding using a play-based teaching approach and found that teachers were positive about play-based approaches at school; they believed that children liked to be actively involved in play. However, in the same study, the researcher was unsure about using a play-based approach in Malaysian preschool classrooms. Ramstetter and Murray (2017) investigated the time for play at school and realized the benefit of recess, or break, as a positive technique for teaching and learning. Edwards (2017) studied whether play, as we perceive it, is an integral part of the daily classroom routine. Participants disclosed that play is an essential aspect of school readiness and an indispensable part of the daily classroom routine.

D. CONCLUSION

Based on the findings of this research, it was concluded that showing mathematical play, love, care, and respect are the most important kinds of practitioners' lived mathematical play practices in the ECCE setting. It was also concluded that the practitioners should ensure that children participate fully in mathematical play-based learning activities through play and broad mathematical experience in childcare. They should also consider the pupils' developmental ages, know their needs, and observe individual differences among the pupils.

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Thus, the researchers recommend that practitioners employ early learning and development areas during play-based mathematics and integrate the teacher's competency, learning, development, and guidance. It will ensure uniformity of what is taught at all the ECCE centers of one district and municipality and prevent each center from implementing its curriculum. Then, the DoE should train practitioners on how best to engage their children in mathematical play-based learning in school.

E. PRACTICAL AND POLICY IMPLICATION OF THE FINDINGS

Some practitioners were expecting three-year-old children to write their names on pages. They seemed to have forgotten that writing development does not happen at that age and that children should pass through several stages of writing skill development before they can write mathematical concepts and symbols. This implies that practitioners should encourage children to use shapes and patterns to communicate mathematical concepts. We also found that they seldomly aligned their activities with the NQF requirements for children from birth to 4 years old. This implies that practitioners lacked exposure to the prescribed curriculum, and those who had access to the document did not follow it.

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