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The Role of Manipulatives in Enhancing Grade R Mathematics Learning in Isixhosa

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Abstract

This article investigates how the use of manipulatives such as counters, beads, number blocks and geometric shapes supports the development of foundational numeracy skills among Grade R learners in isiXhosa-speaking classrooms. Many learners in these settings struggle with early mathematics due to language barriers and limited educational resources. Drawing on Piaget's Theory of Cognitive Development and Vygotsky's Sociocultural Theory, the research highlights the importance of concrete, hands-on learning experiences and the role of language and social interaction in understanding mathematical concepts like counting, number recognition, patterns, and shapes. Using a qualitative case study approach, data were gathered through classroom observations, teacher interviews, and focus group discussions. Participants included purposively selected teachers and learners from isiXhosa-speaking schools where manipulatives were actively used. Thematic analysis revealed that manipulatives help bridge conceptual gaps by making abstract ideas more accessible. The article also identified challenges, including insufficient teacher training and a lack of materials. To enhance the effectiveness of manipulatives, the article recommends targeted teacher development and increased investment in classroom resources. The findings highlight the value of manipulatives in early mathematics instruction and provide practical insights for teachers, curriculum planners, and policymakers aiming to improve numeracy education in linguistically diverse South African classrooms.

Keywords: *Manipulatives, Early Mathematics Education, isiXhosa-speaking Classrooms, Grade R Learners, Numeracy Development*

1. Introduction

Early childhood mathematics education is crucial for establishing the foundational numeracy skills needed for future academic success. In South Africa, Grade R, the first formal year of schooling, relies on effective teaching strategies to support learners' understanding of mathematical concepts. One such strategy is the use of manipulatives—physical objects that make abstract mathematical ideas more accessible. These tools aid cognitive development by bridging the gap between abstract concepts and tangible understanding. In the Eastern Cape, where isiXhosa is widely spoken,

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using manipulatives in isiXhosa classrooms can better align with learners' linguistic and cultural backgrounds, enhancing their learning experiences.

The use of manipulatives in mathematics education is widely recognised for supporting young learners' understanding of abstract concepts. Manipulatives are physical objects that help represent abstract mathematical ideas and support the development of number concepts (Moyer, 2001). The Curriculum Assessment Policy Statement (CAPS) for Grades 1-3 highlights the importance of using concrete models in teaching mathematics (Department of Basic Education, 2012). This aligns with the Concrete Representational Abstract (CRA) instructional approach, which encourages learners to begin with hands-on materials before moving toward mmm abstract reasoning (Witzel, 2005). Research also indicates that using manipulatives can improve learners' retention of concepts and foster a positives attitude toward mathematics learning (Wilkins, 2010).

Challenges exist in implementing manipulatives effectively in isiXhosa-speaking classrooms. Studies have highlighted the need for better strategies to manage manipulatives to enhance mathematical thinking (Mntunjani *et al.*, 2018). Misalignments in mathematical translations from English to isiXhosa can hinder comprehension (Booi *et al*., 2023). A recent study in the Eastern Cape by Sikhwari and Feza (2024) found that manipulatives connect physical experiences to abstract concepts. However, proper teacher training is essential for maximizing their benefits. Considering linguistic, cultural, and pedagogical factors, this study will explore the benefits and challenges of using manipulatives in isiXhosa-speaking Grade R classrooms.

Many Grade R classrooms in South Africa, particularly those using isiXhosa as the medium of instruction, face challenges in effectively implementing manipulatives despite their proven benefits for early mathematics education. A major issue is the lack of resources in underprivileged schools, leading to the reliance on abstract teaching methods that hinder cognitive development (Mntunjani *et al.,* 2018). Additionally, teachers often lack adequate training in using manipulatives, limiting opportunities for active learning and conceptual understanding. Language barriers also pose difficulties, as certain mathematical concepts lack direct translations in isiXhosa, complicating comprehension (Mntunjani *et al.*, 2018; Sikhwari and Feza, 2024). This study seeks to examine how manipulatives can improve Grade R mathematics learning in isiXhosa-speaking classrooms, addressing challenges related to resources, teacher training, and language barriers.

Therefore, this article aims to explore the effectiveness of manipulatives in enhancing mathematics learning in isiXhosa-speaking Grade R classrooms. The following questions guide the research:

- How do manipulatives enhance the conceptual understanding, engagement, and retention of mathematics among Grade R learners?
- How does the use of isiXhosa as the medium of instruction influence the effectiveness of manipulatives, and what strategies can be used to integrate isiXhosa terminology for better mathematical comprehension?
- What are the main challenges affecting the effective use of manipulatives in Grade R classrooms where isiXhosa is the main language of instruction?

2. Conceptualization

2.1. Manipulatives

Manipulatives are crucial in early mathematics education, helping young learners understand abstract concepts through hands-on experiences with physical objects like counting blocks and shape cut-outs (Sarama and Clements, 2020). Rooted in constructivist learning theories, manipulatives support cognitive development by allowing learners to interact with mathematical ideas (Piaget, 1952; Siegler and Lortie-Forgues, 2019). In isiXhosa-speaking classrooms, integrating manipulatives with home language instruction enhances understanding by bridging abstract concepts with real-life experiences, and using isiXhosa terminology strengthens comprehension and problem-solving (Maseko and Mofu, 2021; Muthivhi, 2023).

Challenges such as limited resources, inadequate teacher training, and a focus on rote learning hinder the effective use of manipulatives in South African schools. Teachers often lack the strategies needed to integrate manipulatives effectively into lessons, underscoring the need for professional development programs (Modise and Mpofu, 2022). This research aims to identify best practices for improving Grade R mathematics education by exploring how manipulatives can facilitate hands-on, language-integrated learning in isiXhosa-speaking classrooms.

2.2. Early Mathematics Learning

Early mathematics learning is crucial for building foundational numeracy skills in young children. Key concepts such as number recognition, counting, pattern formation, spatial awareness, and basic arithmetic provide the cognitive framework needed for future academic success. These early skills support problem-solving, logical thinking, and a deeper understanding of the world (Muller and Canella, 2023; Sommers, 2020). Number recognition helps children link symbols to values, while counting teaches them about quantity and sequence, laying the groundwork for future math tasks like addition and subtraction (McDonald *et al.*, 2021; Shumba *et al.*, 2021).

Learning patterns promote problem-solving and critical thinking, while spatial awareness supports skills needed for geometry and measurement (Nyama and Dumisa, 2020; Muller and Canella, 2023). Introducing basic arithmetic operations like addition, subtraction, multiplication, and division builds on these skills, preparing children for more complex mathematical reasoning (Sommers, 2020). Early mathematics is also a social process, where children use number-related language to engage with their environment. A strong foundation in these areas fosters academic success and a lifelong appreciation for learning, and teachers must adopt strategies that consider cultural and contextual factors to nurture these skills (Shumba *et al*., 2021).

3. Theoretical Framework

This study is grounded in Jean Piaget's Theory of Cognitive Development and Lev Vygotsky's Sociocultural Theory to explore the role of manipulatives in enhancing Grade R mathematics learning in isiXhosa. Piaget's theory emphasizes that children construct knowledge through interaction with their environment, particularly in the preoperational stage of cognitive development, where hands-on experiences are crucial for grasping abstract concepts. Manipulatives are physical tools that bridge the gap between abstract ideas and concrete experiences, helping children understand mathematical concepts like number recognition, spatial awareness, and pattern formation through sensory interaction (Piaget, 1952; Sommers, 2020).

Vygotsky's theory, on the other hand, highlights the social and cultural dimensions of learning. According to Vygotsky, children's cognitive development is shaped by social interactions and guidance from more knowledgeable individuals, such as teachers. In Grade R, manipulatives act as mediating tools within the Zone of Proximal Development, helping learners understand mathematical concepts with teacher scaffolding (Vygotsky, 1978). Vygotsky highlights the role of language in shaping thinking, suggesting that manipulatives integrated with learners' native languages, like isiXhosa, support both mathematical and language development (Shumba *et al*., 2021). This study shows how manipulatives foster cognitive and social learning in mathematics by combining Piaget's constructivist approach with Vygotsky's focus on social interaction and language.

4. Literature Review

Effective early mathematics teaching requires strategies that promote understanding and engagement. This section examines the importance of manipulatives, the role of language in instruction, and the challenges in their implementation. It highlights how manipulatives aid learning, especially in isiXhosa-speaking classrooms, while identifying barriers to effective use.

4.1. The Importance of Manipulatives in Early Mathematics Learning

Research indicates that using manipulatives—physical or digital objects that serve as hands-on teaching aids—enhances young learners' understanding of mathematical concepts by making abstract ideas more concrete (Sikhwari and Feza, 2024). These tools allow learners to concretize abstract ideas, establish connections between manipulatives and abstract mathematical concepts, and develop long-term mathematical skills (Mentz and De Beer, 2018).

Studies have shown that hands-on learning experiences improve engagement and retention in mathematics. For instance, a meta-synthesis integrating findings from 12 qualitative or mixed-methods studies concluded that the use of manipulatives in mathematics classes yields compelling evidence of their value in improving several aspects of mathematics education (Angco, 2023). The kinesthetic activity associated with manipulatives can lead students to internalize activities, enabling them to carry out these activities in imagination, thereby reinforcing their understanding (Norton *et al.*, 2024).

In the context of early childhood education, manipulatives are ubiquitous. However, findings regarding their efficacy for learning mathematics concepts are inconsistent. To ensure that manipulatives promote learning when used with young children, it is essential to consider principles from cognitive science. These principles can guide the effective

integration of manipulatives into instruction, thereby enhancing their educational impact (McNeil and Jarvin, 2007).

In South Africa, the use of manipulatives in early mathematics education has been explored in various studies. For example, research focusing on foundation phase teachers' use of manipulatives to teach number concepts found that learners' mathematics performance is aligned to an understanding of number concepts rooted in the foundation phase (Mentz and De Beer, 2018). The study emphasized the importance of effectively managing manipulatives to advance mathematical thinking and reasoning.

Furthermore, a study investigating the basic numeracy abilities of isiXhosa-speaking Reception year students highlighted the role of manipulatives in supporting mathematical understanding. The research suggested that using resources such as manipulatives can support mathematical thinking, particularly when instruction is delivered in the learners' home language (Feza, 2016).

Integrating manipulatives in early mathematics education can significantly enhance learners' comprehension of mathematical concepts by providing concrete representations of abstract ideas. When effectively implemented, manipulatives are valuable tools in fostering engagement, improving retention, and supporting the development of foundational mathematical skills.

4.2. The Role of Language in Mathematics Instruction

Language is a crucial factor in mathematics instruction, particularly in isiXhosa-speaking classrooms, where it helps learners grasp complex concepts. Using isiXhosa alongside manipulatives bridges linguistic barriers, making abstract mathematical ideas more accessible. Since mathematical symbols are deeply embedded in language, understanding them in one's home language fosters deeper comprehension and engagement, especially in the Foundation Phase (Setati and Essien, 2021; Makalela, 2020). Research shows that learning mathematics in isiXhosa enhances problem-solving skills and encourages active participation, aligning with South Africa's multilingual education policies, which advocate for mother tongue instruction to improve mathematical literacy (Moschkovich, 2019; Heugh and Skutnabb-Kangas, 2022).

Despite these advantages, isiXhosa-speaking learners face challenges due to the dominance of English as the medium of instruction in South Africa. Many students struggle with mathematical terminology while also learning a new language, which negatively affects comprehension (Probyn, 2020). Studies suggest that integrating isiXhosa into instruction strengthens problem-solving skills, boosts confidence, and enables learners to connect mathematical concepts with their cultural and linguistic background (Botes and Mji, 2021; Setati, 2023). Additionally, the combination of home language instruction and manipulatives provides a concrete way for students to engage with abstract mathematical concepts, improving their overall understanding (Ngubane and Mokgwathi, 2022).

Implementing isiXhosa in mathematics instruction is hindered by limited resources, inadequate teacher training, and negative perceptions of indigenous languages (Makalela, 2020). Many educators lack proficiency in teaching mathematics in isiXhosa due to insufficient training and a shortage of quality instructional materials (Probyn, 2020). Furthermore, economic factors contribute to the continued prioritization of English, despite evidence supporting the benefits of home language instruction (Heugh and Skutnabb-Kangas, 2022). Addressing these issues requires better teacher training, the development of isiXhosa mathematical resources, and policies that promote the value of indigenous language instruction to ensure an inclusive and effective learning environment.

4.3. Challenges in Implementing Manipulatives in Grade R Mathematics Education

The implementation of manipulatives in Grade R mathematics, particularly in isiXhosa-speaking classrooms, faces several challenges despite their proven benefits in enhancing comprehension and engagement. Key obstacles include limited resources, inadequate teacher training, overcrowded classrooms, and misconceptions about manipulatives' importance.

A major barrier is the lack of resources in underprivileged and rural South African schools. Financial constraints force schools to prioritize textbooks over hands-on learning tools, limiting access to manipulatives and leading to inequalities in mathematics instruction (Spaull and Jansen, 2019). As a result, many teachers rely on rote-learning methods, which may not effectively support early mathematical development (Mavuru and Ramnarain, 2021).

Teacher training gaps further hinder the effective use of manipulatives. Many Foundation Phase educators recognize their benefits but struggle with selecting appropriate materials and designing meaningful activities due to insufficient professional development (Chikiwa and Schafer, 2020). Training programs often fail to emphasize hands-on methodologies, leaving teachers unprepared to integrate manipulatives, especially in multilingual classrooms where language barriers complicate instruction (Pournara *et al.*, 2021).

Overcrowded classrooms also limit the effective use of manipulatives. Large class sizes make managing individualized support and hands-on activities difficult, while space constraints create storage and distribution challenges (Msimanga, 2022).

Misconceptions about manipulatives contribute to their inconsistent use. Some educators and administrators see them as supplementary rather than essential teaching tools, leading to their undervaluation in the curriculum (Mashiya and Moonsamy, 2023). Addressing this requires stronger policy support and clearer curriculum guidelines emphasizing the importance of manipulatives in early mathematics education.

Increased funding, targeted professional development, and improved classroom management strategies are needed to overcome these challenges. By addressing these issues, isiXhosa-speaking learners in South Africa can fully benefit from manipulatives' role in strengthening mathematical understanding and engagement.

5. Methodology

This study adopts a qualitative research approach to explore the role of manipulatives in enhancing mathematics learning in Grade R classrooms within isiXhosa-medium schools. A case study design was selected to provide an in-depth understanding of how teachers integrate manipulatives into their teaching practices and the challenges they encounter. This design allows for a detailed examination of real-life experiences and teaching strategies in their natural settings.

Data collection involved semi-structured interviews and classroom observations. The interviews were conducted with seven Grade R teachers from isiXhosa-medium schools, selected through purposive sampling. This sampling method ensured that participants had relevant teaching experience and could provide rich insights into using manipulatives in early mathematics education. The semi-structured nature of the interviews allowed for flexibility in questioning while ensuring that key themes related to manipulatives, instructional strategies, and challenges were explored in depth. Classroom observations provided additional context by capturing how teachers used manipulatives in practice, how learners engaged with them, and what challenges arose during lessons. These observations complemented the interview data, strengthening the study's findings through triangulation.

Thematic analysis was used to analyse the data, allowing for identifying patterns and themes related to using manipulatives in Grade R mathematics instruction. This method enabled a detailed exploration of teachers' perceptions, instructional methods, and challenges, contributing to a comprehensive understanding of the research problem. The study was limited to isiXhosa-medium schools in a single province, ensuring a focused examination of language-specific instructional practices while acknowledging that findings may not be generalizable to all contexts.

Triangulation was employed to enhance the trustworthiness of the study by combining data from interviews and classroom observations. This approach ensured a more reliable and well-rounded understanding of the research problem. Ethical considerations were carefully addressed by obtaining informed consent from all participants and securing ethical clearance from relevant educational authorities. Participants were assured of confidentiality, and their responses were anonymized to protect their identities. Through these measures, the study maintained ethical integrity while generating meaningful insights into the role of manipulatives in early mathematics education.

6. Presentation of Findings and Discussion

This section presents the findings and discusses key themes related to using manipulatives in Grade R mathematics learning, particularly in isiXhosa-speaking classrooms. The themes identified in this article are designed to explore the role of manipulatives in enhancing conceptual understanding, the influence of language in mathematics instruction, the challenges that hinder effective use, and strategies for improving manipulative-based teaching. By addressing these themes, we aim to provide a comprehensive understanding of how manipulatives can be better utilized to support early mathematics education in multilingual settings.

6.1. Theme 1: The Impact on Number Recognition and Counting

The findings from the participants' responses illustrate the significant role that manipulatives and teaching materials play in supporting number recognition and counting in Grade R classrooms. The responses indicate that teachers observed various improvements in learners' ability to recognize numbers, count forward and backward, and understand fundamental mathematical concepts such as addition, subtraction, patterns, and shapes.

Several teachers emphasized that manipulatives assisted in distinguishing numerical differences, recognizing shapes, and developing counting abilities. **Teacher 1** stated**,** *"When learners touch and move the objects, they can see the*

differences in size, shape, and color. They even learn to name them in isiXhosa, which makes learning more meaningful." For example, learners counted forward and backward using isiXhosa number names such as *"unxantathu"* (triangle) and *"isikwere"* (square). This aligns with Piaget's (1952) theory of cognitive development, which posits that children learn best through active engagement and hands-on experiences.

Teacher 2 highlighted**,** *"When learners physically move counters or beads, they seem to understand numbers better. It's easier for them to grasp addition and subtraction because they can see and feel the changes in quantity."* This observation supports Bruner's (1966) enactive mode of representation, where learners construct knowledge through direct interaction. Similarly, **Teacher 3** observed**,** *"Learners who struggled with counting improved when we used real objects. They enjoy counting forward and backward, and they even started solving simple sums independently."* This supports research by Clements and Sarama (2020), which states that tangible learning aids contribute to conceptual understanding in early mathematics education.

Teachers also noted that verbal activities, rhymes, and songs reinforced number recognition and counting skills. **Teacher 6** emphasized**,** *"Counting happens everywhere in my class—during morning greetings, storytime, and even when lining up. Learners sing number rhymes, which helps them remember sequences better."* This finding supports research by Van Oers (2010), which suggests that integrating numeracy into everyday activities enhances young learners' mathematical thinking.

The role of manipulatives in matching quantities with number symbols was also a recurring theme. **Teacher 1** explained**,** *"At first, many learners could not connect the number symbols to actual quantities. But they slowly started matching numbers correctly with number cards and blocks."* This supports the findings by Siegler and Ramani (2009), who argue that exposure to number games fosters numerical competence. Similarly, **Teacher 7 noted,** *"Learners enjoy working independently on patterns using different shapes. They feel confident when they get it right and even help each other."* According to Sarama and Clements (2009), pattern recognition is a foundational mathematical skill that strengthens problem-solving abilities.

Teachers also indicated that the materials supported various mathematical concepts, including measurement, operations, and spatial awareness. **Teacher 5 highlighted,** *"I use bottle tops and small stones for addition and subtraction exercises. The learners count them, add some, and take some away. This makes them understand 'more' and 'less' in a practical way."* This approach is consistent with the constructivist perspective, which emphasizes learning through doing (Vygotsky, 1978). **Teacher 6 further pointed out,** *"I see that learners are now aware of relationships like 'greater than' and 'equal to.' When they compare objects, they grasp these concepts faster."* This aligns with Geary's (2011) findings on the importance of early numeracy skills.

Regarding the use of the mathematics dictionary, most teachers reported that it was an effective resource in teaching number development, shapes, space, and measurement. **Teacher 5 shared,** *"I use the dictionary to explain math words in isiXhosa, like 'ukongeza' for addition and 'ukwahlula' for division. It helps learners understand the terms better."* This demonstrates its role in bridging linguistic and mathematical understanding, as highlighted by Moschkovich (2019), who emphasizes the importance of language in mathematical comprehension, particularly for bilingual learners.

Most teachers expressed their intention to continue using these materials, with recommendations for improvements. **Teacher 1 suggested,** *"We need more posters with numbers and shapes so learners can see them daily."* **Teacher 5 recommended,** *"Using stories and games in math lessons makes it more fun. When learners are engaged, they remember better."* These suggestions align with research by Klibanoff *et al.* (2006), which emphasizes the significance of storytelling and games in early childhood numeracy.

Findings suggest that manipulatives and teaching materials significantly enhance number recognition and counting skills in Grade R learners. Integrating physical objects, verbal activities, and language-based resources creates a comprehensive learning environment that fosters mathematical understanding. Future improvements could focus on expanding available resources and incorporating additional multimodal strategies to support early numeracy development further.

6.2. Theme 2: Enhancing Spatial Awareness and Shape Recognition

The use of manipulatives and concrete materials plays a pivotal role in enhancing spatial awareness and shape recognition among Grade R learners. Teachers in the study acknowledged the significance of these materials in supporting various

areas of learning, including mathematics, literacy, number recognition, patterns, and life skills. The findings revealed that manipulatives improved teaching effectiveness and fostered cognitive development among the learners.

Teachers observed that manipulatives contributed significantly to understanding shapes and spatial relationships. For example, Teacher 1 shared, "Manipulatives assisted me in knowing their differences, size, different colors, and their names in isiXhosa. For example, names of shapes such as *'unxantathu, isikwere, iqanda limbhoxo' (triangle, square, oblong)*." This response highlights how the materials helped learners grasp spatial awareness's conceptual and linguistic aspects. This finding supports Clements and Sarama's (2019) argument that early exposure to shape recognition can promote both mathematical thinking and language development.

Further support for the impact of manipulatives came from **Teacher 5**, who mentioned, "*The material I used in games and activities helped the learners improve their number recognition skills and develop a better understanding of counting.*" This statement echoes van Nes and de Lange (2020) research, which emphasizes the importance of interactive learning tools in strengthening early numeracy through hands-on experiences.

Manipulatives were also reported to enhance teaching strategies. **Teacher 4** reflected on how manipulatives supported shape recognition, stating, "*I helped them recognize the shapes even if they saw them on the walls. It helped them know the shapes by words."* This aligns with Piaget's theory of cognitive development, which suggests that children construct knowledge through active interactions with their environment (Piaget, 1952). **Teacher 6** also emphasized the integration of numeracy into daily routines, noting, "*Counting learners can learn verbal counting—smaller than, counting on, counting forward, counting backward. We learn maths anytime, anywhere."* This highlights the value of everyday experiences in reinforcing mathematical concepts, as Gelman and Gallistel (2021) discussed.

Pattern recognition was another area where manipulatives made a notable difference. **Teacher 7** explained, "*With the help of shapes, learners can follow the pattern I gave them. Doing it practically, they find repetitive patterns, showing enjoyment in doing the activity*." This finding is supported by Papic and Mulligan (2015), who argue that engaging learners in hands-on patterning activities enhances their ability to identify and predict sequences, a skill essential for mathematical development.

Symbolic learning also benefited from the use of manipulatives. **Teacher 2** explained, "*These materials improve my teaching by physically manipulating an object. It also improves by touching, moving, or performing hand tasks."* The concept of embodied cognition (Wilson and Golonka, 2013) reinforces this, suggesting that physical interactions with objects deepen the learning experience.

The use of the mathematics dictionary emerged as another key tool in enhancing mathematical vocabulary and conceptual understanding. **Teacher 5** stated, "*I use the dictionary to explain concepts such as addition 'ukongeza' and division 'ukwahlula' to learners and help them understand them.*" This approach is supported by Vygotsky's (1978) theory, which underscores the role of language in cognitive development, particularly in the context of mathematical learning. Furthermore, **Teacher 1** shared, "*I share the dictionary in my community; it helps learners a lot and motivates them."* This practice highlights the importance of home-school connections, as emphasized by Anthony and Walshaw (2020), in fostering mathematical literacy.

The study demonstrates that manipulatives and related materials profoundly enhance spatial awareness, shape recognition, and mathematical understanding in Grade R learners. The teachers' experiences underscore the effectiveness of these resources in improving teaching methods, engaging learners, and promoting conceptual growth. The findings align with existing literature on interactive and multisensory learning benefits. Moving forward, the study recommends expanding resources, integrating more visual aids, and incorporating digital tools to enrich the learning experience for young children further.

6.3. Theme 3: Teacher Perceptions of Engagement and Learning Outcomes

The findings from interviews with Grade R teachers reveal the significant impact that educational materials, including manipulatives, mathematics dictionaries, and workshop experiences, have had on teaching strategies and student outcomes. Teachers reported that these materials supported a variety of learning areas, such as number recognition, counting, shape recognition, and pattern development. Notably, manipulatives were identified as a key tool in supporting mathematical understanding and promoting language development. For example, Teacher 1 shared that manipulatives helped learners recognize shapes and build their vocabulary in isiXhosa: "*Manipulatives assisted me to know their differences, size, different colours, and their names in isiXhosa*" (**Teacher 1).** This suggests that manipulatives were valuable for teaching mathematical concepts and contributed to language acquisition by helping students connect visual and verbal knowledge.

Incorporating mathematics into daily activities was another theme that emerged from the interviews. Teacher 6 observed that counting and number knowledge were integrated into routine activities like morning rings and story time, reinforcing mathematical concepts outside of formal lessons. "*Counting learners are able to learn verbal counting...We learn maths anytime, anywhere"* (**Teacher 6).** This aligns with Vygotsky's (1978) social constructivism, which emphasizes learning through interaction with the environment and social context. By using manipulatives in everyday settings, teachers created an environment where mathematics was embedded into daily routines, enhancing students' engagement and understanding.

Teacher 5 also emphasized the importance of manipulatives in making learning more engaging and interactive. "*The material offered fun and created ways to help learners learn about shapes and patterns," and "We learn about more, less, greater than, fewer than, and equals to*" (**Teacher 5**). These comments illustrate how manipulatives supported abstract concepts like mathematical operations and patterns by providing hands-on, playful learning opportunities. This view aligns with Piaget's (1952) concrete operational theory, where children use physical interaction with objects to develop abstract reasoning skills.

The role of manipulatives in supporting both mathematical and language development was a consistent theme across interviews. **Teacher 1** explained how manipulatives were used to teach shapes in isiXhosa, with terms like "*unxantathu, isikwere, iqanda limbhoxo" (triangle, square, egg-shaped)* to reinforce both math and language skills. This approach aligns with Piaget's (2011) concept of concrete operational learning, where children interact with physical objects to make sense of abstract concepts.

The mathematics dictionary was another valuable resource mentioned by teachers. **Teacher 5** highlighted its utility in explaining basic concepts like addition ("*ukongeza*") and division ("*ukwahlula*") in isiXhosa, stating, "*I use the dictionary to explain these concepts to learners and help them understand them"* (**Teacher 5**). Teacher 6 also noted its usefulness in explaining more complex terms such as volume ("*umthamo*") and weight ("*ubunzima*"). This suggests that providing bilingual resources, like the mathematics dictionary, can help bridge language gaps in multilingual classrooms, where learners may struggle with English-language mathematical instruction. This supports Setati's (2005) findings, emphasizing the importance of integrating local languages into mathematics instruction to improve comprehension and retention in multilingual settings.

Professional development workshops also played a vital role in improving teachers' teaching practices. **Teacher 4** mentioned that attending workshops focused on using isiXhosa in mathematics instruction made teaching easier, as it helped her use the correct mathematical terms. "*The learners understood easily because, in their language, it helped me the most to use the correct terms*" (**Teacher 4**). This highlights the importance of language-specific training for teachers, particularly in multilingual contexts, as it enhances the accessibility of mathematical concepts and fosters deeper student understanding.

Teachers also suggested areas for improvement. Some teachers recommended including additional resources, such as posters for visual learners and educational games, to make learning more enjoyable. **Teacher 6**, for instance, emphasized the need to expand materials to include coding and robotics resources, reflecting the growing importance of these subjects in the curriculum. This aligns with Brodie's (2012) assertion that continually updating and diversifying teaching materials is essential for addressing the evolving needs of young learners.

Using manipulatives and other educational materials has proven to be a valuable strategy for enhancing teaching practices and student learning outcomes in Grade R classrooms. These materials supported mathematical and language development and fostered increased engagement and enjoyment. There is room for improvement, particularly in expanding the range of materials to meet the evolving educational needs, such as incorporating emerging technologies like coding and robotics, which are becoming integral to the curriculum.

6.4. Theme 4: Challenges and Suggested Improvements

The participants were asked to share their perspectives on how teaching materials, particularly manipulatives, and resources like a mathematics dictionary, influenced their Grade R classroom teaching. Through their responses, several common themes emerged, especially related to challenges faced and suggestions for improvement in the use of teaching materials.

Many teachers expressed that the materials supported key areas of their teaching. For instance, **Teacher 1** pointed out that manipulatives were helpful in teaching shapes, such as triangles and squares, and in reinforcing the names of these shapes in isiXhosa: *"Using the shapes helped them not only recognize the shapes but also learn the names in*

isiXhosa, like 'unxantathu' for triangle." This aligns with existing research on the role of hands-on materials in fostering spatial awareness and cognitive development in early learners (Piaget, 1964; Sarama and Clements, 2009). Similarly, **Teacher 6** noted that manipulatives were instrumental in number recognition and counting, which are foundational in early mathematics education: *"Manipulatives helped my learners understand numbers, especially in the early stages of counting and recognizing quantities."* **Teacher 5** also emphasized that manipulatives, particularly shapes and patterns used in games, helped build learners' understanding: *"The shapes, when used in games, really helped my learners build a strong foundation in understanding how numbers and shapes relate."* **Teacher 7** shared that these tools enabled students to create and recognize patterns independently: *"Manipulatives allowed my learners to independently create and recognize patterns, which was a huge boost in their learning."*

The teachers also highlighted how the materials enhanced their teaching. **Teacher 1** remarked that manipulatives facilitated not only shape recognition but also bilingual learning, as students learned the names of shapes in both English and isiXhosa: *"The manipulatives weren't just about shapes, they also helped integrate language learning because the students were learning both English and isiXhosa terms for shapes."* **Teacher 2** elaborated on how using objects helped learners grasp counting, particularly at the early stages of number development: *"When they used objects, it became easier for them to grasp the concept of counting. It gave them something tangible to connect to the numbers they were learning."* This perspective is supported by research showing the importance of concrete materials in developing numeracy skills (Clements and Sarama, 2014). **Teacher 6** described how manipulatives were incorporated into daily activities like storytime and morning circles, reinforcing the idea that mathematics should be integrated into everyday life: *"I used manipulatives during story time and in our morning ring, which helped students see how math is part of everything we do."* These insights are consistent with the theories of Vygotsky (1978), who emphasized learning through social interaction and hands-on activities.

While the materials were generally regarded as beneficial, the teachers also noted several challenges. **Teacher 3** identified a lack of materials as a barrier to effective teaching: *"We don't have enough materials to engage all my students fully, and that makes teaching more difficult."* This is a significant concern, as access to adequate resources is crucial for delivering quality education (UNESCO, 2017). **Teacher 4** similarly desired more visual learning materials, such as posters: *"I think posters would be really helpful in reinforcing concepts and giving the children something to refer to visually."* **Teacher 2** suggested including more sensory tools, such as blocks, to assist learners with fine motor difficulties: *"Blocks and other sensory tools would really help students who struggle with fine motor skills."* This approach resonates with research advocating multisensory learning to address diverse learning needs (Katz, 2009).

Regarding improvements, Teacher 5 recommended including educational games and stories that integrate mathematical concepts: *"We need to include more educational games and stories that combine math with fun so that students can connect more easily with the content."* **Teacher 6** also pointed out the growing need for resources that address emerging areas like coding and robotics: *"The kids should be exposed to concepts like coding and robotics early, so we need to get resources that support that."* This highlights the relevance of preparing young learners for 21st-century skills (Yelland, 2016).

The mathematics dictionary was cited as a valuable resource by several teachers. **Teacher 1** shared that it helped learners understand fundamental concepts like counting: *"The math dictionary was helpful for teaching concepts like counting. It gave them simple explanations they could understand."* **Teacher 2** found it useful for teaching in isiXhosa, as it helped overcome challenges in conveying mathematical terms in the learners' home language: *"It was a real challenge teaching in isiXhosa without the dictionary. It made a huge difference in helping them understand the terms."* **Teacher 5** highlighted the dictionary's role in teaching operations like addition and subtraction in isiXhosa: *"The dictionary was essential in explaining things like addition and subtraction in isiXhosa. It really helped students grasp these concepts in their home language."* This practice is supported by research on the advantages of bilingual resources in early education (García and Wei, 2014). **Teacher 7** found the dictionary particularly helpful in bridging language barriers: *"Many of my students speak better English than isiXhosa, so the dictionary helped bridge the language gap."* This highlights the need for bilingual resources to facilitate learning in the early years (Snow, 2010).

Teachers reported positive experiences with the materials, especially manipulatives and the mathematics dictionary. These resources supported various aspects of learning, including number recognition, shape identification, basic mathematical operations, and reinforcing language skills. However, the lack of adequate and diverse resources emerged as a key challenge. The teachers' suggestions for improvement included expanding the range of available materials, incorporating multisensory tools, and ensuring that resources are culturally and linguistically relevant. These findings emphasize the importance of providing comprehensive and contextually appropriate materials to enhance the quality of early childhood education.

The findings highlight the beneficial role of manipulatives in improving mathematical understanding, especially when combined with isiXhosa instruction. However, their effectiveness is limited by challenges such as a lack of resources and insufficient teacher training. The discussion emphasizes the need for improved learning materials, specialized teacher training, and strategies to overcome language barriers. Addressing these challenges will help ensure that manipulatives support a deeper understanding of mathematics among Grade R learners.

7. Recommendations

To improve mathematics learning, schools should be equipped with a variety of manipulatives, such as blocks, shapes, and counting tools, to make abstract concepts more tangible. These tools help cater to different learning styles and enhance engagement, making math more interactive and accessible. Teachers should also receive ongoing professional development through workshops focused on effectively integrating manipulatives into lessons, helping them address challenges and stay updated on best practices.

Developing isiXhosa mathematics dictionaries and instructional materials is essential to bridge language barriers, especially in multilingual classrooms. These resources can aid students in understanding mathematical terms in their home language, improving comprehension and communication of mathematical ideas.

Policy support is also crucial for incorporating manipulatives into early childhood mathematics curricula. Governments and educational authorities must prioritize the availability of resources, provide training, and establish guidelines for their use. By embedding these practices into the curriculum, manipulatives can become an integral part of teaching, improving the overall learning experience for young learners.

8. Conclusion

This article highlights the important role of manipulatives in improving Grade R mathematics learning, especially for isiXhosa-speaking learners. Using manipulatives has been found to improve learners' ability to recognize numbers significantly, understand shapes, and engage with mathematical activities. However, challenges such as a lack of resources and inadequate teacher training still limit the full potential of these tools. Providing schools with the necessary resources and professional development for teachers is essential to address these challenges. Overcoming these barriers will help create a more supportive learning environment and ensure that manipulatives can effectively enhance mathematics teaching for young learners.

This study also emphasizes the need for policy changes that prioritize the inclusion of manipulatives in early childhood education. Policy support is essential to secure the resources, funding, and teacher training required to use manipulatives effectively. Future research should focus on exploring the long-term impact of manipulatives on learning outcomes, especially in multilingual classrooms where learners may face additional language challenges. By examining how manipulatives can be scaled in diverse educational settings, future studies can offer valuable insights into integrating these tools into mathematics teaching on a broader scale, leading to more inclusive and effective educational practices.

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