



Mathematics Education in Early Childhood Development in Nigeria: Challenges, Opportunities and Policy Directions

¹Abu Abubakar & ²Saka Abdulganiyu

Corresponding Author: abuabubakarikcoe@gmail.com

¹Department of Early Childhood Care Education Isa Kaita College of Education, Dutsinma, Katsina State

²Department of Adult and Continue Education, Federal University Wukari, Taraba State, Nigeria

DOI: <https://doi.org/10.5281/zenodo.17365972>

Abstract

Mathematics education in early childhood represents a critical foundation for cognitive development, academic success, and future mathematical literacy. This paper examines the current state of mathematics education in early childhood development in Nigerian: challenges, opportunities and policy direction. Through a comprehensive review of literature and current research, this study identifies key barriers including teacher shortages, inadequate resources, curriculum misalignment, and socioeconomic disparities that hamper effective mathematics instruction for young learners aged 3-8 years. The paper proposes evidence-based recommendations for policy reform, teacher professional development, and innovative pedagogical approaches that could transform early childhood mathematics education in Nigeria.

Keywords: Early Childhood Education, Mathematics Education, Nigeria, Educational Challenges, Policy Implementation, Teacher Training.

Introduction

Early childhood education (ECE) serves as the cornerstone of lifelong learning and development, with mathematics education playing a pivotal role in shaping young minds' cognitive abilities and problem-solving skills. In Nigeria, where 43% of the 213 million citizens are under 14 years of age, the significance of quality early childhood mathematics education cannot be overstated (Oxford Business Group, 2024). The formative years from ages 3 to 8 represent a critical window for mathematical concept development, spatial reasoning, and numeracy skills that form the foundation for future academic success. Despite the recognized importance of early mathematics education, Nigeria faces substantial challenges in delivering quality mathematical instruction to its youngest learners. These challenges are compounded by rapid population growth, with an annual increase of 2.7% creating unprecedented demands on the educational system. (Oxford Business Group, 2024). The integration of mathematics education within early childhood development programs requires urgent attention to ensure that Nigerian children develop the mathematical competencies necessary for success in an increasingly technology-driven global economy. This paper provides a comprehensive analysis of the current state of mathematics education in early childhood development in Nigeria, examining the multifaceted challenges that impede effective implementation while identifying promising opportunities for transformation and improvement.

Literature Review

A. Theoretical Framework for Early Childhood Mathematics Education

research in early childhood mathematics education is grounded in constructivist learning theories by Piaget (1952) and Vygotsky (1978) which emphasize the active role of children in building mathematical understanding through hands-on experiences and social interactions. The National Association for the Education of Young Children (NAEYC) emphasizes that young learners' future understanding of mathematics requires an early foundation based on high-quality, challenging, and accessible mathematics education. Contemporary research indicates that mathematics learning in early childhood follows predictable developmental trajectories, with children naturally developing informal mathematical concepts through play and exploration before formal instruction begins. This understanding has significant implications for curriculum design and pedagogical approaches in the Nigerian context. Nigerian children learn through social interaction with peers, siblings and parent which is in line with Vygotsky's social constructivism where children mathematical understanding

can be built in their interactive settings where they engage in trading, farming and traditional games that consist of counting, measuring, and sharing. Constructivist creates a framework for exploiting these cultural practices in building children's mathematical understanding. The approach doesn't only support children's entry behaviour but also link informal numeracy experiences with formal school mathematics thereby making learning more meaningful, rational and culturally responsive.

B. Global Trends in Early Childhood Mathematics Education

International research demonstrates that effective early childhood mathematics programs share several key characteristics: play-based learning environments, integration of mathematics with other subjects, use of manipulative materials, and emphasis on mathematical reasoning rather than rote memorization. In 2024, educators globally are embracing STEAM (Science, Technology, Engineering, Arts, and Mathematics) principles to foster creativity, innovation, and critical thinking skills in young learners. The integration of technology and digital tools in early childhood mathematics education has emerged as a significant trend, with research showing positive impacts on engagement and learning outcomes when appropriately implemented. However, the digital divide presents particular challenges in developing contexts like Nigeria. Globally many early childhood policies emphasises literacy over numeracy despite longitudinal research demonstrating that early mathematics skills are a stronger predictor of academic success more than early reading skills(Zhou et al., 2022)

C. The Nigerian Environment: Current State of Early Childhood Mathematics Education

Educational System Structure

Nigeria's educational system follows a 9-3-4 structure, with early childhood education officially recognized as the foundation level. The National Policy on Education acknowledges ECE as comprising programs and activities critical to holistic development, academic success, and future achievements of children. However, implementation of these policies remains inconsistent across the country's 36 states and Federal Capital Territory. Despite the fact that its regarded as foundational for human capital development, Early Childhood Care and Education (ECCE) has to been optimally utilized in Nigeria and evenly accessed. Investigation revealed that as of mid-2024, only 36 percent of Nigerian children aged 3–5 years attend ECCE programs, leaving approximately 10 million children without access to pre-primary education (Gazette Nigeria, 2024a; Tribune Online, 2024).

Furthermore, attendance rates are subject to stark socio-economic disparities: just 8 percent of children from the poor and disadvantage background enroll in ECCE, compared to as high as 78–87 percent among children from rich and privilege background (ICIR, 2024; Gazette Nigeria, 2024a). Worsening the access gap is acute shortage of teachers, with over seven million learners sharing only about 154,000 ECCE educators, leading to inadequate pupil–teacher ratios that hinder teaching quality and learning outcomes (ICIR, 2024; UNICEF, 2024). Not least, ECCE canters across Nigeria—especially public and rural one often suffer from gross inadequate infrastructure, lack of play-based materials, lack of proper monitoring arrangements, and insufficient funding in early learning environments (Gazette Nigeria, 2024a; UNICEF, 2024).

At the policy and intervention level, efforts toward improving ECCE quality have shown promise, yet remain localized and underfunded. A play-based curriculum initiative, initiated in 2015 and led by UBEC in collaboration with UNICEF, focuses on training pre-primary teachers, using low-cost materials, and engaging communities in Ebonyi and Adamawa States (UNESCO, 2023). Moreover, the need for more systematic policy reform and budgetary prioritization is urgent—particularly in underserved areas like the North-West—where ECCE consistently receives lower allocations relative to primary and secondary education, despite the long-term developmental returns associated with early learning (Gazette Nigeria, 2024b; The Times, 2024). Considering the investigations by UNICEF’s 2024 on the current state assessment emphasizing poor access to quality education and the broader persistence of regional inequalities in child welfare, improving ECCE infrastructure, teacher capacity, and resource allocation should be a strategic focus for national education reform in Nigeria (UNICEF, 2024).

Policy Framework and Government Initiatives

The Nigerian government has demonstrated commitment to improving educational outcomes through various initiatives aimed at addressing literacy and numeracy challenges. Recent policy developments include efforts to ensure gender parity in education and address the significant number of out-of-school children, which affects early childhood education enrolment and participation. The government's focus on digital literacy initiatives presents opportunities for integrating technology-enhanced mathematics instruction in early childhood programs. Government initiative to operationalize are spearheaded by Universal Basic Education Commission (UBEC). Recent initiatives have integrated digital literacy and numeracy as part of the national education agenda. The National

digital economy policy and strategy (2020-2030) (Federal Republic of Nigeria, 2020) the National Digital Literacy framework (NITDA,2023) and the National Digital Learning Policy(UNESCO-IICBA,2023) support the incorporation of technology into teaching and learning. UBEC's Smart Education Projects additionally promote teacher digital competence and model classrooms, supporting the use of developmentally appropriate digital tools to promote early numeracy instruction. However, the gap between policy formulation and implementation remains a significant challenge.

D. Major Challenges in Early Childhood Mathematics Education in Nigeria

The major challenges confronting Early Childhood Education amongst others include: Human resource challenges, infrastructural and resource constraints, curriculum and assessment challenges, socio-economic and cultural factors, technology and digital divide

i. Human Resource Challenges

- **Teacher Shortage and Qualification Issues:** One of the most critical challenges facing mathematics education in Nigeria is the acute shortage of qualified teachers, particularly those with specialized training in early childhood mathematics education. This shortage is most pronounced in rural and disadvantaged communities, where the need for quality education is often greatest. The lack of educators with appropriate training in age-appropriate mathematical pedagogy significantly impacts the quality of instruction young children receive. The teacher shortage is exacerbated by several factors including inadequate compensation, poor working conditions, and limited opportunities for professional development. Many teachers working in early childhood settings lack specific training in mathematics education, relying instead on traditional pedagogical approaches that may not be developmentally appropriate for young learners.
- **Professional Development Deficiencies:** Existing professional development programs for early childhood educators often lack focus on mathematics-specific content and pedagogy. Teachers require ongoing support to develop competencies in creating engaging mathematical experiences, using manipulative materials effectively, and assessing young children's mathematical understanding in authentic contexts.

ii. Infrastructure and Resource Constraints

- **Inadequate Learning Materials:** The scarcity of appropriate learning materials represents a significant barrier to effective mathematics instruction in early childhood settings. Many schools lack basic manipulative materials, mathematical games, and age-appropriate resources that are essential for hands-on mathematical exploration. This shortage forces teachers to rely heavily on abstract instruction methods that are inappropriate for young learners' developmental needs.
- **Physical Infrastructure Limitations:** Many early childhood education centres in Nigeria operate in inadequate physical spaces that do not support interactive mathematical learning. The lack of proper classrooms, learning centres, and outdoor spaces for mathematical exploration limits teachers' ability to implement research-based pedagogical approaches.

iii. Curriculum and Assessment Challenges

- **Curriculum Misalignment:** Current curriculum frameworks often fail to reflect contemporary understanding of how young children learn mathematics. There is frequently a disconnect between stated curriculum objectives and the developmental appropriateness of instructional expectations. Many curricula emphasize rote memorization and procedural skills rather than mathematical reasoning and problem-solving abilities.
- **Assessment Inadequacies:** Assessment systems in many early childhood programs fail to provide teachers with meaningful information about children's mathematical understanding and progress. Traditional assessment approaches often rely on standardized testing methods that are inappropriate for young learners and do not capture the full range of mathematical competencies children develop.

iv. Socioeconomic and Cultural Factors

- **Poverty and Access Issues:** Socioeconomic disparities significantly impact access to quality early childhood mathematics education. Families in poverty may lack resources to support their children's mathematical development at home, and may be unable to afford quality early

childhood programs. This creates educational inequities that can have lasting impacts on children's academic trajectories.

- **Cultural Attitudes toward Mathematics:** Cultural attitudes toward mathematics education, including gender stereotypes and beliefs about mathematical ability, can influence children's early experiences with mathematics. Addressing these cultural factors requires comprehensive community engagement and awareness programs.

v. **Technology and Digital Divide**

The digital divide presents both challenges and opportunities for early childhood mathematics education in Nigeria. While technology offers innovative possibilities for mathematical learning, many communities lack access to digital tools, internet connectivity, and technological infrastructure necessary to implement technology-enhanced instruction

vi. **Impact of Current Challenges**

- **Educational Outcomes:** The cumulative effect of these challenges is reflected in poor mathematical achievement outcomes among Nigerian students. International assessments and national studies consistently demonstrate significant gaps in mathematical competency, with roots often traceable to inadequate early childhood mathematics experiences.
- **Long-term Consequences:** Poor early childhood mathematics education has cascading effects throughout the educational system and into adulthood. Students who lack strong mathematical foundations in early years often struggle with mathematics throughout their academic careers, limiting their opportunities for higher education and career advancement in STEM fields.
- **Economic Implications:** The inadequate preparation of young people in mathematics has broader economic implications for Nigeria's development goals. As the country seeks to diversify its economy and increase participation in technology-driven industries, mathematical literacy among the population becomes increasingly critical.

E. **Emerging Opportunities and Innovations**

The Emerging opportunities and Innovations focused on policy and structural opportunities in the following major thematic areas: Government commitment to Education reforms, Pedagogical innovations, Technology Integration opportunities and their sub-themes.

i. Policy and Structural Opportunities”

- **Government Commitment to Education Reform:** Recent government initiatives demonstrate increased commitment to educational improvement, including efforts to address teacher shortages and improve educational infrastructure. The focus on digital literacy creates opportunities for innovative approaches to mathematics education that leverage technology while remaining developmentally appropriate.
- **International Partnerships and Support:** Nigeria's participation in global educational initiatives and partnerships with international organizations provides opportunities for knowledge exchange, technical assistance, and resource mobilization to support early childhood mathematics education improvements.

ii. Pedagogical Innovations

- **Play-Based Learning Approaches:** Growing recognition of the importance of play-based learning in early childhood education creates opportunities to implement more effective mathematics instruction. Research-based approaches that integrate mathematical concepts into natural play activities can make learning more engaging and meaningful for young children.
- **STEAM Integration:** The trend toward STEAM education provides opportunities to integrate mathematics with other subjects in ways that make learning more relevant and engaging. This approach can help children see connections between mathematics and real-world applications while developing critical thinking skills.

iii. Technology Integration Opportunities

- **Mobile Learning Solutions:** The widespread adoption of mobile technology in Nigeria creates opportunities for innovative mobile learning solutions that can support mathematics education even in resource-constrained environments. Educational apps and games designed

for young learners can supplement classroom instruction and provide additional practice opportunities.

- **Digital Resource Development:** The development of locally relevant digital resources for early childhood mathematics education presents opportunities to address content and language barriers while making learning more culturally relevant and engaging for Nigerian children.

iv. Community and Parental Engagement

- **Family Mathematics Programmes:** Programmes that engage families in supporting their children's mathematical development at home can significantly enhance learning outcomes. These programs can help parents understand the importance of early mathematics education and provide them with tools and strategies to support their children's learning.
- **Community-Based Initiatives:** Community-based early childhood education programs can help expand access to quality mathematics education, particularly in underserved areas. These programs can leverage local resources and knowledge while implementing evidence-based pedagogical approaches.

Future Research Directions

As Mathematics Education in Early Childhood Education continue to evolve its imperative for studies that expand upon these result. The following directions are suggested to guide future research:

- **Context-Specific Research Needs:** Additional research is needed to better understand the specific challenges and opportunities for early childhood mathematics education in the Nigerian context. This includes “Investigating the impact of mobile –based numeracy games in ECCE classrooms in Nigeria. “Investigating the impacts of parental involvement in promoting mathematical understanding among the pre-primary school children in Nigeria Rural communities. Pedagogical approaches, assessment methods, and professional development models that work in Nigerian settings.

- **Longitudinal Studies:** ‘‘Early Numeracy Experiences and Children’s Long-Term Academic Outcome in Nigeria: A Longitudinal Analysis. Longitudinal Study of Early Numeracy Exposure and Later Academic Success? A Longitudinal Study.

Summary and Conclusion

Mathematics education in early childhood development represents a critical opportunity to build strong foundations for lifelong learning and success. In Nigeria, addressing the significant challenges facing early childhood mathematics education requires comprehensive, coordinated efforts involving policy reform, teacher development, resource provision, and community engagement. The challenges are substantial, including teacher shortages, inadequate resources, curriculum misalignment, and socioeconomic barriers. However, emerging opportunities including government commitment to education reform, technological innovations, and growing recognition of the importance of early childhood education provide hope for significant improvements. Success will require sustained commitment from government, educators, communities, and development partners. The stakes are high. Nigeria's future economic development and competitiveness depend in large part on the mathematical literacy of its population. By investing in quality early childhood mathematics education today, Nigeria can build the foundation for a more prosperous and equitable future for all its children.

The significance of mathematics education in early childhood development extends far beyond academic achievement. It encompasses cognitive development, problem-solving abilities, logical reasoning, and the confidence to engage with mathematical concepts throughout life. For Nigeria, with its young and rapidly growing population, the opportunity to transform early childhood mathematics education represents not just an educational imperative, but a national development priority.

Recommendations

The above discussion illustrates the centrality of mathematics education in early childhood development in Nigeria: challenges, opportunities and policy directions. In reflecting on this topic, the following points are proposed for consideration;

1. Curriculum and assessment Challenges: The curriculum contents should be age appropriate and implementation should be meaningful, rational and activity based instead of rote

memorization Assessment tools and practices should be valid, reliable, appropriate and sufficient in assessing the holistic mathematical understanding of young children. To achieve this, is to develop and implement a culturally relevant and age-appropriate mathematics curriculum that aligns with Nigerian early childhood development needs. Incorporate local frameworks and practical activities to foster meaningful learning experiences.

2. **Teacher Training and Professional Development:** Invest in continuous professional development programmes for early childhood educators to improve their understanding of effective mathematics teaching strategies. Emphasize the importance of hands-on, manipulative materials, play-based approaches to make mathematics engaging and accessible.
3. **Resource Allocation, physical space and Learning Materials:** Increase investment in teaching resources, such as manipulative, visual aids, and digital tools, to support interactive and experiential learning. Ensure equitable distribution of these materials across urban and rural settings. Early Childhood centres should be spacious for so as to promote indoor and outdoor mathematical exploration and interaction.
4. **Economic and Social Factor:** Encourage parental involvement and community participation in early mathematics education through awareness campaigns, and close learning gap across social and economic divide. Remove social and economic barriers that prevent parent from enrolling their children in to early childhood education during the first few years of brain development: By building a supportive environment at home can reinforce mathematical concepts learned in school.
5. **Technology and Digital Divide** by promoting access to technological and digital devices: Children from poor and disadvantage background should have access to digital devices and internet by government and NGOS' Promote research initiatives to continually assess the effectiveness of mathematics education programmes at the early childhood level. Use findings to inform policy reforms aimed at addressing existing challenges and leveraging future opportunities for sustainable development.

The above recommendations drawn in this paper provide a roadmap for transformation, but implementation will require careful planning, adequate resources, and ongoing commitment to quality improvement.

References

- Athena Centre for Policy and Leadership. (2025, August 13). *Tackling Teacher Shortages in Nigeria: Recruitment, Training, and Retention Strategies*. Premium Times. Location: Abuja Nigeria.
- Business Day. (2024, October 19). *Learning crisis persists as teacher, shortage worsens in Nigeria*. Business Day: Location: Lagos Nigeria.
- Business Day. (2022, October 20). *Only 36% of Nigerian children attend early childhood education – UNICEF*. Business Day: Location: Lagos Nigeria.
- Clements, D. H., & Sarama, J. (2021). *Learning and teaching early math: The learning trajectories approach* (3rd ed.). Routledge.
- Cross, C. T., Woods, T. A., & Schweingruber, H. (Eds.). (2009). *Mathematics learning in early childhood: Paths toward excellence and equity*. National Academies Press.
- Disciplines.ng. (2024, June 11). Key challenges in Nigeria's mathematics education. Retrieved from <https://disciplines.ng/mathematics-education-challenges/>
- Federal Republic of Nigeria. (2013). *National Policy on Education* (6th ed.) Abuja: NERDC
- Federal Republic of Nigeria. (2020) National Digital Economy Policy and Strategy(2020-2030). Location: Abuja: Nigeria
- Ginsburg, H. P., Lee, J. S., & Boyd, J. S. (2008). Mathematics education for young children: What it is and how to promote it. *Social Policy Report*, 22(1), 1-22.
- ICIR Nigeria. (2023, April 20). *Key data on early childhood education in Nigeria*. ICIR Nigeria.

National Association for the Education of Young Children. (2020). *Early childhood*

mathematics: Promoting good beginnings. Position statement. NAEYC.

National Council of Teachers of Mathematics. (2020). Mathematics in early childhood learning. Position statement. Retrieved from <https://www.nctm.org/standards-and-positions/position-statements/mathematics-in-early-childhood-learning/>

National Information Technology Development Agency(NITDA). (2023). National Digital Literacy Framework. Abuja: NITDA

Obioma, G. (2016). Challenges in implementation of early childhood education in Nigeria: The way forward. *International Journal of Educational Research and Reviews*, 4(3), 234-241.

Oxford Business Group. (2024, December 31). What is Nigeria doing to improve education outcomes? *Africa 2023 Report*. Retrieved from <https://oxfordbusinessgroup.com/reports/nigeria/2024-report/>

Portobello Institute. (2024, September 18). Top trends in early childhood education in 2024. Retrieved from <https://blog.portobelloinstitute.com/top-trends-in-early-childhood-education-in-2024>

Professions.ng. (2023, September 27). Math education in Nigeria: Challenges and innovations. Retrieved from <https://professions.ng/math-education-in-nigeria/>

Punch Nigeria. (2025, July 20). *Nigeria's teacher shortage crisis*. Punch Editorial Board.

Research Gate. (2015). Early childhood education in Nigeria: Policy implementation critique and a way forward. Retrieved from <https://www.researchgate.net/publication/283573329>

Sarama, J., & Clements, D. H. (2009). *Early childhood mathematics education research: Learning trajectories for young children*. Routledge.

UNESCO. (2015). *Education for All 2000-2015: Achievements and challenges*. UNESCO Publishing. Location: Paris, France

UNESCO Institute for Statistics. (2019). *New methodology shows that 258 million children, adolescents and youth are out of school*. UNESCO. Location: Montreal: Canada

UNESCO International Institute for Capacity Building in Africa(IICBA). (2023). Education Country brief:Nigeria(Includes the National Digital Learning Policy, May 2023) UNESCO –IICBA Location: Addis Ababa

United Nations. (2015). *Transforming our world: The 2030 agenda for sustainable development*. United Nations General Assembly. Location: New York, United State

UNICEF Nigeria. (n.d.). Education. UNICEF Nigeria. Location: Abuja Nigeria

Weiland, C., & Yoshikawa, H. (2013). Impacts of a prekindergarten program on children's mathematics, language, literacy, executive function, and emotional skills. *Child Development, 84*(6), 2112-2130.

World Bank. (2018). *World development report 2018: Learning to realize education's promise*. World Bank Group ..Location: Washington DC, United States

Yoshikawa, H., Weiland, C., Brooks-Gunn, J., Burchinal, M. R., Espinosa, L. M., Gormley, W. T., & Zaslow, M. J. (2013). Investing in our future: The evidence base on preschool education. Society for Research in Child Development.

ZDM Mathematics Education. (2020). Research on early childhood mathematics teaching and learning. *ZDM – Mathematics Education, 52*(4), 607-619.

Zhou, X., Cragg, L., Gilmore, C., & Xu, F. (2022). Why do early mathematics skills predict later mathematics and reading achievement? The role of executive function. *Journal of Experimental Child Psychology, 214*, 105306.