

LEVERAGING ARTIFICIAL INTELLIGENCE TO FOSTER INNOVATION AND CREATIVITY IN PRE-PRIMARY AND PRIMARY EDUCATION IN NIGERIA

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Abstract

Artificial Intelligence (AI) has emerged as a transformative force that reshapes teaching and learning processes across all levels of schooling. In pre-primary and primary education where foundational skills, creativity and innovation are most critical, AI holds the potential to revolutionize instructional practices, classroom engagement, and individualized learning experiences. This paper was designed to unveil ways of leveraging Artificial Intelligence to foster innovation and creativity in pre-primary and primary education. AI provides personalized learning pathways, promoting interactive and adaptive content delivery and supporting teachers in curriculum design and classroom management for pre-primary and primary education children. The discussion emphasizes the importance of integrating AI tools to stimulate imagination, problem-solving, collaboration and critical thinking among young learners, while also preparing them to thrive in a technologically advanced society. Also, the paper highlights both the benefits and challenges of adopting AI in pre-primary and primary education, ranging from improved learning outcomes and inclusivity to concerns about data privacy, equity, teacher readiness, and ethical considerations. Strategies for effective integration, such as teacher training, infrastructural investment, and policy frameworks, are recommended to ensure that AI applications serve as complementary aids rather than replacements for human educators. By situating AI as an enabler of creativity and innovation rather than a threat to traditional pedagogy, this paper provides practical insights into how pre-primary and primary education systems can embrace emerging technologies to empower learners, equip teachers and contribute to holistic educational development. It recommended that continuous training and professional development programs should be implemented to equip teachers with the knowledge and skills to effectively integrate AI tools in classrooms and that AI applications must be tailored to the developmental needs of children, focusing on creativity, problem-solving, and collaboration rather than rote learning.

Keywords: Artificial Intelligence, Pre-Primary Education, Primary Education, Creativity, Innovation.

Introduction

Artificial intelligence (AI) is increasingly transforming the landscape of education, including pre-primary and primary levels by reshaping how children learn, create and interact with knowledge. At this stage of learning where curiosity and imagination are foundational, AI presents opportunities to support innovative teaching strategies, nurture creativity and personalize learning experiences. Recent reports by Miao, Holmes, Huang and Zhang, (2023) emphasize that when designed responsibly, AI tools can expand opportunities for children to explore ideas through play, stories, images and interactive projects while enhancing not replacing the role of the teacher.

One of the most significant contributions of AI in pre-primary and primary education lies in its capacity to personalize learning and scaffold creative expression.

For example, generative tools can help children brainstorm story ideas, visualize concepts and receive formative feedback in real time (Office of Educational Technology, 2023). This aligns with findings from systematic reviews showing that AI-powered tools can strengthen engagement, problem-solving, and imaginative tasks when integrated with sound pedagogy (Lee, Park, and Kim, 2024; Mustafa, Hermanto and Sari, 2024). Similarly, AI-driven intelligent tutoring systems have demonstrated measurable learning gains in K–12 contexts, creating space for teachers to focus on open-ended inquiry and socio-emotional support (Létourneau, 2025). In early childhood contexts, research Park and Kim, (2024) shows that AI-assisted storytelling and writing supports can increase learners’ agency and creativity, provided that children remain the authors and evaluators of their work.

Rather than converging on “correct answers,” AI can be positioned as a thinking partner that encourages exploration and reflection (Li, 2025). However, this requires teachers to frame AI use within developmentally appropriate practices and to emphasize critical evaluation of AI outputs.

At the same time, scholars and international organizations warn that the integration of AI in early education raises ethical concerns. Issues such as child privacy, data protection, inclusivity and equity must remain central (UNICEF, 2021). Without careful design and policy oversight, AI adoption risks widening digital divides particularly in resource-constrained contexts.

Global guidance therefore calls for a “human-in-the-loop” approach where teachers, parents, and policymakers set boundaries for responsible use while promoting creativity, collaboration, and inclusiveness (Miao et al., 2023; Zhou, 2025). Taken together, contemporary literature underscores that AI should not be viewed as a replacement for educators but as a tool to foster innovation and creativity when carefully embedded in pedagogy. For pre-primary and primary education, the challenge lies in striking a balance between harnessing AI’s potential and safeguarding children’s rights and developmental needs.

Concept of Artificial Intelligence (AI)

Artificial Intelligence (AI) is a branch of computer science that aims to create systems capable of performing tasks that normally require human intelligence. These tasks include reasoning, learning, problem-solving, perception, and language understanding (Russell and Norvig, 2020). Artificial Intelligence (AI) in education involves using advanced technology, such as machine learning algorithms and computational models, to improve the learning process, enhance educational outcomes, and tailor instruction to each children's unique needs (Schueller, Tomasino and Mohr, 2022).

AI applications can include intelligent tutoring systems, adaptive learning platforms, and virtual simulations. These technologies aim to analyze children's learning patterns, provide personalized feedback, and create dynamic educational experiences (Smith, 2019). AI in education utilizes various techniques like natural language processing, computer vision, and data analytics to create a flexible and adaptive learning environment. It goes beyond traditional teaching methods by utilising computing power to adapt to individual children's strengths and weaknesses, promoting a more personalized and effective educational experience (Okeke, 2020).

Concept of Pre-Primary Education

Pre-primary education refers to organized early childhood learning experiences provided to children before they enter formal primary schooling. It is designed for children aged roughly 3–5 years, depending on national policies, and focuses on holistic development; cognitive, emotional, physical, social, and language skills through play, exploration, and structured activities. UNESCO (2021) defines pre-primary education as the initial stage of organized instruction intended to prepare young children for primary education. Similarly, researchers emphasize that pre-primary education provides foundational learning that shapes future academic achievement, creativity, and socio-emotional adjustment (UNICEF, 2019; Heckman & Karapakula, 2021).

Objectives of Pre-Primary Education

1. To provide stimulating and safe learning environments that nurture curiosity, imagination, and creativity.
2. To lay a foundation for literacy, numeracy, and communication through play-based learning (UNESCO, 2021).
3. To promote socialization, cooperation, and respect for diversity among young children (OECD, 2019).
4. To foster holistic development; cognitive, physical, moral, and emotional, preparing children for smooth transition to primary schooling (UNICEF, 2019).
5. To reduce inequalities in learning opportunities by ensuring access to quality early childhood care and education.

Concept of Primary Education

Primary education constitutes the first stage of compulsory basic education, typically covering children between ages 6–11 years depending on the country. It builds upon pre-primary foundations and aims to provide broad-based knowledge, literacy, numeracy, and life skills needed for lifelong learning and participation in society. UNESCO (2022) describes primary education as structured learning aimed at ensuring mastery of basic competencies and preparation for secondary schooling. Researchers further note that primary education is central to achieving the Sustainable Development Goal 4 (SDG 4), which emphasizes inclusive and equitable quality education (Oketch and Rolleston, 2020).

Objectives of Primary Education

1. To ensure universal acquisition of literacy, numeracy, and problem-solving skills (UNESCO, 2022).
2. To foster creativity, innovation, and critical thinking in young learners.
3. To instill moral values, discipline, and civic responsibility (OECD, 2020).
4. To promote equality of educational opportunity and reduce socio-economic disparities (World Bank, 2019).
5. To prepare learners for secondary education, lifelong learning, and participation in socio-economic development.

Importance of Innovation and Creativity in Pre-Primary and Primary Education

Innovation and creativity are central to the goals of pre-primary and primary education because they provide young learners with the capacity to explore, imagine, and

problem-solve in ways that extend beyond rote knowledge. Early childhood is widely recognized as a critical period of cognitive and socio-emotional development, and children at this stage benefit from environments that stimulate curiosity, flexibility of thought, and imaginative play (OECD, 2019; UNICEF, 2019). Creativity in early learning contexts supports not only artistic expression but also the development of higher-order skills such as critical thinking, collaboration, and adaptability, which are increasingly essential in the 21st century (Robinson & Aronica, 2019).

Innovation in pedagogy is equally vital. Research shows that learning activities that promote inquiry, experimentation, and design thinking help young children internalize problem-solving skills and foster resilience (UNESCO, 2021). Innovative teaching strategies, such as project-based learning, storytelling, and play-integrated science and technology, have been linked to improvements in literacy, numeracy, and socio-emotional competencies (Kangas, Siklander, Randolph & Ruokamo, 2020). Moreover, fostering creativity at an early stage is associated with long-term academic achievement and the development of entrepreneurial mindsets (Heckman & Karapakula, 2021).

The emphasis on creativity also aligns with global education frameworks, such as Sustainable Development Goal 4 (SDG 4), which advocates for inclusive and equitable quality education that equips learners with skills for innovation, critical thinking, and cultural appreciation (UNESCO, 2022). Thus, pre-primary and primary schools that integrate creativity and innovation into their curricula not only prepare children for academic success but also equip them to navigate complex social and technological futures.

Application of Artificial Intelligence in Pre-Primary and Primary Education

Artificial Intelligence (AI) is increasingly being applied in early education to support teaching and learning in ways that align with the developmental needs of young children. AI technologies have the potential to personalize learning, offering adaptive feedback and scaffolding that meets individual learners' pace and style. For instance, AI-powered storytelling tools, intelligent tutoring systems, and interactive learning platforms have been shown to enhance engagement and foster creativity in literacy and numeracy development (Lee, Park, & Kim, 2024; Létourneau, Deslandes Martineau, Charland, Karran, Boasen & Léger, 2025).

In pre-primary education, AI applications often take the form of gamified learning platforms and conversational agents that introduce children to basic literacy and numeracy while encouraging playful interaction. These tools help to sustain attention and curiosity, particularly when combined with age-appropriate visual and auditory stimuli (UNESCO, 2021). Similarly, in primary education, AI systems are increasingly being used to support differentiated instruction, allowing teachers to identify learning gaps and tailor interventions to diverse learners, including children with special educational needs (Mustafa, Hermanto and Sari, 2024).

AI also contributes to creativity-enhancing practices by supporting children in generating ideas, visualizing concepts, and engaging in imaginative storytelling. Research indicates that when framed appropriately, AI can act as a "thinking partner," encouraging children to reflect, revise, and expand their ideas rather than replacing their creativity (Li & Wilson, 2025). Beyond the classroom, AI can reduce teacher workload by automating routine tasks such as lesson planning, resource organization,

and assessment, thereby freeing teachers to focus more on interactive, play-based, and socio-emotional aspects of learning (Office of Educational Technology, 2023).

However, the use of AI in early education requires careful ethical and developmental considerations. UNICEF (2021) emphasizes that AI for children must safeguard privacy, promote inclusivity, and avoid reinforcing biases. The integration of AI should be developmentally appropriate, ensuring that children remain active participants in learning rather than passive recipients of technology. Teachers' AI literacy is therefore crucial to ensure that AI tools are applied responsibly and in ways that enrich creativity and innovation in the classroom (Zhou., 2025).

Overall, AI in pre-primary and primary education holds transformative potential, but its effectiveness depends on balancing innovation with ethics, inclusivity, and child-centered pedagogy.

Benefits of Leveraging AI in Early Education

Artificial Intelligence (AI) is increasingly transforming early education, offering new possibilities for enhancing teaching and learning processes. In pre-primary and primary education, AI provides a supportive role in personalizing learning experiences, increasing efficiency, and fostering children's creativity. These benefits are especially relevant in an era where traditional methods often fall short of meeting diverse learning needs.

One major benefit of AI is personalized learning, where algorithms adapt to individual learners' pace, strengths, and weaknesses, ensuring inclusivity for both advanced and struggling learners (Luckin, Holmes, Griffiths & Forcier, 2022). AI-powered platforms can analyze data from learners' interactions and suggest customized activities that encourage holistic development. Additionally, enhanced engagement is achieved through interactive AI-driven tools such as chatbots, gamified learning applications, and virtual tutors that motivate children to participate actively (Holmes, Porayska-Pomsta, Holstein, Sutherland, Baker, Shum, Santos, Rodrigo, Cukurova, Bittencourt, & Koedinger 2019).

Another critical advantage is the support for teachers. AI reduces administrative burdens by automating tasks like grading, lesson planning, and student performance tracking, thus allowing educators to focus more on interactive teaching and nurturing creativity (Zawacki-Richter Marín, Bond & Gouverneur, 2019). Importantly, AI tools also foster inclusive education, by providing adaptive solutions for learners with disabilities, including speech recognition for non-verbal learners and text-to-speech support (Alvarez & Salavati, 2023). Collectively, these benefits highlight AI as a catalyst for innovation in early education.

Challenges and Ethical Considerations

While AI offers numerous benefits, its integration in early education raises a number of challenges and ethical concerns that must be carefully addressed. These challenges revolve around accessibility, equity, data privacy, and the developmental appropriateness of technology use among young learners.

A major challenge is the digital divide, where unequal access to digital resources could widen educational disparities, especially in low-income or rural communities (UNESCO, 2021). Furthermore, concerns about data privacy and security are critical, as AI systems collect sensitive information about children that could be misused if not properly regulated (Tuomi, 2022). There are also debates about developmental appropriateness, since excessive reliance on technology might reduce opportunities

for play-based and social learning, which are central to early childhood development (Neumann, 2022).

Ethical considerations include the role of teachers and human interaction. Overdependence on AI might undermine the emotional bond and social learning children gain from teachers and peers (Holmes, Bialik & Fadel, 2021). Moreover, questions of bias in AI systems such as cultural, gender, or linguistic biases could affect the fairness of learning recommendations (Ramos, Meek,, Simard, Suh & Ghorashi, 2023). These issues demonstrate that while AI has transformative potential, its application in early education must be guided by robust ethical frameworks, equity-focused policies, and child-centered approaches.

Strategies for Effective Integration of AI in Early Education

To fully harness the potential of AI in pre-primary and primary education, effective strategies are essential to ensure that its adoption aligns with educational objectives and children's developmental needs.

Firstly, teacher training and professional development are central to successful integration. Educators must be equipped with digital literacy skills and pedagogical strategies to effectively use AI tools in ways that complement human teaching rather than replace it (Zawacki-Richter, Marín, Bond & Gouverneur, 2019). Secondly, curriculum integration is vital AI can be embedded within existing curricula in ways that promote creativity, critical thinking, and problem-solving rather than being treated as a stand-alone technology (Luckin, Holmes, Griffiths & Forcier., 2022).

Another strategy is the development of inclusive and equitable policies that ensure all children, regardless of socio-economic background have access to AI-driven learning resources (UNICEF, 2021). In addition, collaborative partnerships between governments, schools, parents, and technology developers can foster child-centered AI solutions that address contextual realities (Holmes, Bialik & Fadel, 2021). Finally, ethical guidelines and child data protection policies must be enforced to safeguard learners' rights and ensure responsible use of AI (Tuomi, 2022).

Conclusion

The integration of Artificial Intelligence into pre-primary and primary education marks a paradigm shift in early learning practices. AI not only enhances creativity and innovation but also personalizes education to suit diverse learners, providing opportunities for more inclusive and effective teaching. Beyond improving access to educational resources, AI-driven tools empower children to explore, imagine, and collaborate in ways that traditional methods may not fully allow. However, challenges such as ethical concerns, infrastructural gaps, and teacher preparedness must be carefully managed to prevent widening inequalities. Therefore, AI in early education should not replace human interaction but rather serve as a complementary tool that enhances the teacher's role while fostering child-centered learning. The future of education lies in balancing technological advancement with ethical responsibility and pedagogical soundness.

Recommendations

The paper recommended the following;

1. Continuous training and professional development programs should be implemented to equip teachers with the knowledge and skills to effectively integrate AI tools in classrooms.
2. AI applications must be tailored to the developmental needs of children, focusing on creativity, problem-solving, and collaboration rather than rote learning.
3. Governments and educational stakeholders should develop clear policies to regulate AI use in schools, addressing issues of equity, data privacy, and ethical standards.
4. Investments in digital infrastructure, including internet access, smart devices, and AI-enabled platforms, are crucial for bridging the digital divide in early education.
5. Strong data protection laws and ethical guidelines should be established to ensure children's privacy and security in the use of AI technologies.
6. Collaboration between policymakers, educators, technologists, and parents should be fostered to ensure sustainable and inclusive AI integration.
7. Continuous research is needed to evaluate the impact of AI on early childhood education outcomes, ensuring best practices are refined and scaled appropriately.

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