

## APPLICATIONS OF ARTIFICIAL INTELLIGENCE (AI) POWERED TOOLS IN THE PRIMARY SCHOOL EDUCATION SYSTEM IN THE 21ST CENTURY

<sup>1</sup>NAFISAT BASHIR, ZAINAB MUHAMMAD, ADAMU KADALA MUSA  
& NASIRU AMINU

Department of Educational Psychology and Counselling,  
Ahmadu Bello University, Zaria.  
bashirnafisah081@gamil.com; Zaynabmr207@gmail.com  
ibnmusaadamukadala@gmail.com; nasirua913@gmail.com

### Abstract

This review investigates the application of AI-powered tools in the primary school education system, emphasizing their growing significance in modern teaching and learning. As artificial intelligence continues to transform educational practices globally, understanding its role at the primary level is essential, given that tools designed for higher education may not suit younger learners. AI applications, such as coding games and AI-driven storytelling platforms, encourage creativity, problem-solving and critical thinking, while making learning engaging and interactive. These tools also support collaborative activities, allowing students to work together on projects, thereby fostering teamwork and communication skills. Additionally, AI enables teachers to analyze student performance data, identify learning gaps, and adapt instruction to meet individual needs, enhancing personalized learning experiences. The review highlights that integrating AI tools into primary education can create dynamic classroom environments that captivate students while equipping them with foundational technological skills essential for the 21st century. For effective implementation, the study recommends comprehensive teacher training, practical application of AI tools, and continuous adaptation to students' evolving learning needs. Overall, the findings indicate that AI-powered tools, when thoughtfully applied, significantly enhance teaching and learning, improving academic engagement, creativity, and skill development in Nigerian primary schools.

**Keywords:** Artificial Intelligence (AI), Primary School, Storytelling, AI powered Tools, Review.

### Introduction

Artificial intelligence (AI) has become one of the most transformative technologies of the 21st century, offering significant potential to enhance teaching and learning in primary education in Nigeria. As AI continues to shape daily life from voice assistants to interactive games; it provides opportunities to develop children's critical thinking, creativity and problem-solving skills. In education, AI tools support teachers by enabling the creation of multimedia didactic materials, particularly for teaching literary works in reading lessons. Research in early childhood education demonstrates the effectiveness of AI-supported technologies: Wang (2019) highlighted AI applications such as automated child assessment, AI teaching systems, educational robots, and virtual reality instruction, while Ertel (2018) showed how AI-enhanced learning environments can increase motivation and engagement. These findings emphasize the need for digital readiness among young learners as a foundation for future learning and daily life (Terenzini et al., 2022).

The application of AI in education (AI-Ed) has been studied for decades, integrating insights from learning sciences to develop adaptive, flexible, and inclusive learning environments (Ertel, 2018). Recently, AI-driven storytelling and other interactive tools have gained prominence for their ability to

personalize learning experiences in early childhood settings (Wang, 2019). This is particularly relevant as modern children increasingly prefer digital entertainment over traditional reading, making it harder to cultivate strong reading habits. Yet, reading literary texts remains essential for building vocabulary, coherent expression, communicative competence, and emotional intelligence (Sperling et al., 2022; Lozano & Fontao, 2023). Therefore, there is a growing need to prepare teachers to integrate AI tools that can motivate young learners, enrich reading activities, and strengthen engagement with literature. This review thus explores both the needs and possibilities of applying AI technologies in Nigeria's primary education system to support effective teaching and learning in the 21st century.

Artificial Intelligence (AI).

Artificial Intelligence (AI), a term introduced by John McCarthy in 1956, refers to the development of machines capable of performing tasks that normally require human intelligence (U.S. Department of Education, 2023). AI systems use algorithms, hardware, and data to make decisions, identify patterns, and perform actions, with algorithms functioning as the "brain" behind these operations (Ruiz & Fusco, 2023). Definitions from the Oxford English Dictionary and Microsoft (2024) emphasize AI's ability to think, learn, and act like humans sometimes even surpassing human capabilities. It further explains that AI encompasses various subfields, including machine learning, computer vision, natural language processing, and knowledge representation, all aimed at replicating human cognitive processes.

In education, AI plays an increasingly important role by making teaching and learning more efficient, adaptive, and personalized. AI applications enable learners to access rich and diverse learning resources beyond what traditional instructional methods can provide, thereby accommodating different abilities, learning paces, and learning styles (Casal & Otero, 2023). Through adaptive learning platforms, intelligent tutoring systems, and automated feedback mechanisms, AI supports continuous assessment and timely intervention, helping learners to address knowledge gaps more effectively.

AI in education (AI-Ed) employs technologies such as machine learning and natural language processing to analyze large volumes of learner data, identify individual learning needs, and tailor instructional content accordingly (Lozano & Fontao, 2023). These technologies also assist teachers by generating insights into student performance, reducing administrative workload, and supporting evidence-based instructional decision-making. Ultimately, AI enhances literacy development and general learning outcomes by fostering flexible, data-driven, and learner-centered educational experiences that promote engagement, autonomy, and sustained academic growth.

Research on the application of artificial intelligence (AI) in primary education has expanded significantly, demonstrating its potential to enhance learning, support teachers, and personalize instruction across subjects. Studies have shown that AI-based games and gamified tools can improve young learners' mathematical competence and support students with special educational needs (Pareto, 2024). Generative AI tools such as ChatGPT have also been found effective for personalizing learning materials and responding to students' varying proficiency levels, thereby fostering motivation and skill development (Jauhiainen & Guerra, 2023). Further work on adaptive learning highlights how AI systems adjust instruction in real time to meet learners' needs (Lhafra & Abdoun, 2023; Krumsvik, 2023).

In STEM education, AI-supported robots, intelligent storytelling systems, and collaborative content-sharing platforms have been successfully implemented in primary school settings to enhance pupils' engagement, curiosity, and conceptual understanding (Mehdipour et al., 2018). These tools promote hands-on learning, problem-solving, and computational thinking by allowing learners to interact with intelligent systems through exploration, experimentation, and collaboration. For example, educational

robots can support the learning of basic programming and logical reasoning, while AI-driven storytelling systems help integrate creativity and language development into STEM instruction. Furthermore, recent studies increasingly recognize AI as a valuable teacher assistant rather than a replacement for educators. AI tools can reduce teachers' workload by automating routine tasks such as grading, attendance tracking, and learning analytics, thereby helping to prevent burnout and improve instructional efficiency (Hashem et al., 2024; Morze et al., 2023). AI also supports teachers in assessment, personalized content creation, communication with learners and parents, and instructional design by providing data-driven insights into students' learning progress. When effectively integrated, these AI applications strengthen teaching quality and enable teachers to focus more on pedagogical interaction and learner support.

Alongside practical applications, recent research has examined ethical issues and emerging challenges related to AI integration in primary education. Scholars have proposed frameworks for ensuring privacy, reducing algorithmic bias, and promoting inclusivity (Alawneh et al., 2024), while others warn against the risks of uncontrolled AI adoption and advocate for responsible, human-centered pedagogical approaches (Longo, 2024). Efforts to strengthen AI literacy extend beyond children, with studies exploring how child-computer interaction approaches can help adults and professionals develop confidence in AI-related skills (Kaspersen et al., 2024).

Moreover, empirical studies from countries such as Sweden, China, and Spain have reported positive outcomes in diverse educational contexts, including machine learning education, English language acquisition, teacher professional development, and students' engagement and perceptions of AI tools (Sperling et al., 2022; Garcia-Delgado et al., 2023; Chen & Wang, 2021; Li et al., 2022). Similarly, AI-based personalized learning systems have demonstrated potential in improving learning outcomes among Nigerian primary school pupils by predicting individual learning styles and delivering tailored instructional content (Pardamean et al., 2022; Ibitoye et al., 2025). Despite this growing body of global evidence, research on the integration and practical application of AI in Nigerian primary schools remains limited. Consequently, this study aims to investigate the needs and possibilities of applying AI tools particularly for generating literary and artistic content to enrich primary education in Nigeria, while drawing on lessons and best practices from international experiences (Casal & Otero, 2023).

### **Forms and Applications of Artificial Intelligence in the School**

Applications of Artificial Intelligence (AI) in the School Teaching and Learning Process.

Here are some applications of Artificial Intelligence (AI) in the school teaching and learning process by U.S. Department of Education, Office of Educational Technology (2023):

**Personalized Learning:** AI can help create personalized learning experiences for students by analyzing their learning styles, interests, and strengths, and then tailoring the content and pace of instruction to meet their individual needs.

**Intelligent Tutoring Systems:** These AI-powered systems can provide individualized instruction to students, identifying areas where they need additional help and providing targeted feedback to improve their understanding.

**Adaptive Assessments:** AI-powered assessments can adapt to the student's level of knowledge and provide immediate feedback. This can help teachers identify areas where students need additional support and adjust instruction accordingly.

**Language Learning:** AI-powered language learning tools can help students learn a new language by providing real-time feedback on pronunciation, grammar, and vocabulary.

**Virtual and Augmented Reality:** AI can be used to create virtual and augmented reality learning environments, which provide immersive and engaging experiences for students.

**Chatbots and Virtual Assistants:** AI-powered chatbots and virtual assistants can provide students with

instant support and answers to their questions.

*Social-Emotional Learning:* AI can be used to identify students who may be struggling with social-emotional learning and provide targeted interventions to support their well-being (U.S. Department of Education, Office of Educational Technology, 2023).

### **Benefits of AI in Early Childhood Education**

The inclusion of Artificial Intelligence (AI) in early childhood education offers numerous benefits that can transform learning experiences and support skill development in young learners. Key advantages include:

*Individualized Learning and Personalization:* AI tailors' instruction to each child's learning style, abilities, and pace, ensuring personalized learning pathways that support individual developmental needs.

*Enhanced Engagement and Early Detection of Challenges:* AI tools often use interactive features and gamification such as points, badges, and rewards to boost engagement and motivation. AI-driven assessments also help identify early learning difficulties or developmental concerns (Alam et al., 2022).

*Immersive Learning Through Virtual Reality:* AI-powered VR environments enable children to explore real-world scenarios virtually, deepening conceptual understanding, enhancing spatial reasoning, and increasing retention and enjoyment.

*Predictive Analytics for Early Intervention:* AI systems analyze learning patterns to identify at-risk students and alert teachers for timely intervention. This enables targeted support, personalized guidance, and improved learning outcomes for diverse learners (Alam et al., 2022).

*Development of Critical Thinking Skills:* AI learning activities often present problem-solving tasks and scenarios that encourage children to analyze, evaluate, and make decisions, fostering higher-order thinking (Kok et al., 2024).

*Instant Feedback and Inclusive Learning:* AI provides real-time feedback, helping learners recognize strengths, improve weaknesses, and engage in reflective learning. This supports inclusivity by meeting varied learning needs (Ertel, 2018).

*Early Technological Familiarization:* Introducing AI in early education exposes children to emerging technologies and prepares them for a future where AI and digital tools will be increasingly central to daily life and work.

### **Uses of AI in Primary Schools Education**

Uses of AI Technology Tools in Primary School Education (Liudmyla et al., 2024):

*Reading Lesson Preparation:* Teachers use AI to generate story-based assignments, create character dialogues and narrations, and pose questions from characters' perspectives to support comprehension.

*Creation of Literary and Artistic Content:* AI helps produce multimedia materials that improve text recall, auditory perception, and emotional intelligence, including experimental music and poetry-based songs.

*Video Creation for Reading Motivation:* Platforms like Pictory and InVideo AI enable visually appealing videos that motivate pupils, spark interest in stories, and encourage exploration of authors and literary works.

*Story Visualization and Voiceovers:* Pupils can read stories with visuals, generate dialogues, and record AI-generated voiceovers, aiding poem reading and supporting easier memorization.

*Quick Production of Educational Videos:* AI allows teachers to create learning videos without advanced editing skills. Students can also make photo collages of stories by selecting images, adding music, and recording narration.

## **Challenges of Applying Artificial Intelligence in Primary Schools in Nigeria**

The application of Artificial Intelligence (AI) in Nigerian primary schools is constrained by a range of interconnected systemic and contextual challenges, despite its potential to improve teaching and learning outcomes. Key among these challenges is inadequate infrastructure, as many schools lack reliable electricity, internet connectivity, and basic ICT facilities required for AI-driven educational tools, particularly in rural areas (UNESCO, 2023; Ibitoye et al., 2025).

Financial limitations further hinder AI adoption, given the high costs of acquiring, maintaining, and updating AI technologies amid insufficient government funding for basic education. As a result, many AI initiatives remain donor-dependent and difficult to sustain in the long term. In addition, teacher capacity gaps pose significant barriers, as many primary school teachers have limited digital literacy and receive little or no training in AI-supported pedagogy, leading to resistance and ineffective utilization of AI tools (Ibitoye et al., 2025).

The misalignment of the primary school curriculum with AI integration also limits effective implementation. Current curricula place minimal emphasis on digital literacy, computational thinking, and learner-centered pedagogies, while an examination-oriented system restricts instructional flexibility (Federal Ministry of Education [FME], 2020). Furthermore, weak policy and governance frameworks, including the absence of clear guidelines on AI use, data privacy, and child protection, raise ethical and implementation concerns (NITDA, 2023).

Equity issues remain pronounced, as disparities between urban and rural schools, public and private institutions, and learners from different socio-economic backgrounds widen the digital divide. Many AI tools also lack local and cultural relevance and are rarely adapted for learners with special educational needs, limiting inclusivity (UNICEF, 2022). Finally, sustainability challenges, such as inadequate technical support and rapid technological obsolescence, undermine the long-term viability of AI initiatives in primary schools.

Overall, these challenges suggest that effective AI integration in Nigerian primary education requires coordinated investment in infrastructure, teacher professional development, curriculum reform, robust policy implementation, and equity-focused strategies to ensure inclusive and sustainable adoption.

## **Conclusion**

The integration of AI-powered tools in Nigerian primary schools holds strong potential to enhance teaching and learning through personalized instruction, engaging content, teacher support, and the development of early digital skills. AI can also promote creativity, critical thinking, and problem-solving, preparing learners for a digital future. However, effective adoption requires more than technological introduction; it depends on sustained investment in infrastructure, comprehensive teacher training, supportive and ethical policy frameworks, locally relevant content, and equitable access. Addressing these requirements in a coordinated manner will enable AI to serve as a transformative tool for delivering quality, inclusive, and future-ready primary education in Nigeria.

## **Recommendations**

Engaging pre-service teachers in the use of AI tools enhances their digital literacy skills, preparing them to navigate and harness the potential of emerging technologies in their future classrooms.

Expose pre-service teachers to these innovative teaching methods to encourage them to adopt creative and engaging approaches that can captivate and motivate young learners, thus promoting sustainable student engagement and achievement for creating interactive and immersive learning experiences.

Integrating AI tools into teacher preparation programs nurtures a mindset of lifelong learning and adaptability among future educators. As AI technologies continue to evolve, teachers who are using

these tools will be better equipped to continuously update their practices and adapt to the changing needs of their students, contributing to the long-term sustainability of education.

Continued research is needed to develop more accurate, explainable, and generalizable learner models that can capture the complex cognitive, affective, and motivational states of individual learners. This includes exploring new machine learning techniques, such as transfer learning as well as incorporating multimodal data sources, such as eye tracking and physiological sensors.

AI-powered tools for primary school pupils should be grounded in research-based instructional design principles and learning sciences. This includes designing for active learning, metacognition, and self-regulation, as well as aligning with evidence-based teaching practices and curricula.

Advance in natural language processing and generation can enable more engaging and effective conversational learning experiences. This includes developing more sophisticated dialogue systems that can provide explanations, answer questions, and give feedback in natural language.

Fostering interdisciplinary research and development can lead to more effective and holistic solutions. Interdisciplinary collaboration of stakeholders in advancing AI-powered tools requires close collaboration across multiple disciplines, including computer science, learning sciences, cognitive psychology, instructional design, and education.

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