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Artificial Intelligence Tools as a Model for Effective Teaching and Learning in Adult Education Centers

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Abstract

Artificial Intelligence (AI) is increasingly transforming educational practices by enhancing instructional delivery, learner engagement, assessment, and educational management. This paper examines AI tools as a model for effective teaching and learning in adult education centres. It explores the concepts of Artificial Intelligence and adult education, identifies major AI tools applicable to adult education, and discusses their roles, benefits, challenges, and strategies for effective integration. The paper adopts a conceptual approach based on existing literature and relevant theoretical perspectives. Findings reveal that AI tools such as ChatGPT, Google Gemini, Microsoft Copilot, Grammarly AI, Canva AI, Duolingo, Khanmigo, Quizizz AI, Google NotebookLM, and Speech-to-Text technologies promote personalized learning, intelligent tutoring, automated assessment, research support, digital inclusion, and administrative efficiency. However, challenges including inadequate ICT infrastructure, poor digital literacy, limited funding, ethical concerns, and the absence of institutional AI policies hinder their effective adoption, particularly in developing countries. The paper concludes that AI has the potential to significantly improve the quality, accessibility, and effectiveness of adult education programmes when supported by adequate infrastructure, educator training, enabling policies, and ethical implementation frameworks. It recommends increased investment in digital infrastructure, continuous capacity building for educators, and the development of institutional policies to facilitate the sustainable integration of AI into adult education centres.

Keywords: Artificial Intelligence, Adult Education, AI Tools, Teaching and Learning, Educational Technology, Lifelong Learning.

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Introduction

Artificial Intelligence (AI) has emerged as one of the most transformative technological innovations of the twenty-first century. It is reshaping industries such as healthcare, finance, agriculture, manufacturing, transportation, and education through its ability to simulate human intelligence and automate complex tasks (Russell & Norvig, 2021; UNESCO, 2021). In education, AI-powered technologies have significantly improved teaching methodologies, learning experiences, assessment systems, curriculum delivery, and institutional management by providing adaptive learning environments, intelligent tutoring systems, and automated feedback mechanisms (Holmes et al., 2022; Zawacki-Richter et al., 2019).

Adult education plays a critical role in promoting literacy, lifelong learning, vocational competence, citizenship education, and sustainable development (UNESCO Institute for Lifelong Learning [UIL], 2022). Adult learners differ considerably from conventional school learners because they possess diverse experiences, responsibilities, motivations, and learning preferences. According to Knowles et al. (2020), adult learners are self-directed, goal-oriented, and motivated by practical applications of knowledge. Consequently, teaching strategies

in adult education require flexibility, learner-centred approaches, experiential learning, and relevance to real-life situations (Merriam & Bierema, 2014).

The emergence of AI tools presents new opportunities for adult education centres to provide personalized learning experiences, improve instructional quality, facilitate learner assessment, support self-directed learning, and increase access to educational resources (Luckin, 2018; Holmes et al., 2022). AI-powered applications such as ChatGPT, Google Gemini, Microsoft Copilot, Grammarly, Duolingo, Khanmigo, Quizizz AI, Canva Magic Design, and adaptive learning systems enable educators to design engaging learning environments, generate instructional materials, automate administrative tasks, and provide individualized learning support while helping adult learners overcome educational barriers (Kasneci et al., 2023; Tlili et al., 2023).

Despite these opportunities, the adoption of AI in adult education remains relatively low in many developing countries, particularly Nigeria, due to inadequate digital infrastructure, limited internet connectivity, poor digital literacy among educators and learners, insufficient funding, and the absence of comprehensive institutional policies on AI integration (UNESCO, 2023; OECD, 2021). These challenges continue to widen the digital divide and limit the effective utilization of AI

technologies for lifelong learning. Therefore, examining AI tools as a model for effective teaching and learning in adult education centres has become increasingly important in advancing quality adult education and achieving Sustainable Development Goal 4 (Quality Education).

Concept of Artificial Intelligence

Artificial Intelligence (AI) refers to the branch of computer science concerned with the design and development of computer systems capable of performing tasks that normally require human intelligence. These tasks include learning from experience, reasoning, problem-solving, decision-making, understanding and generating natural language, recognizing speech and images, and adapting to new information (Russell & Norvig, 2021). AI enables machines to mimic cognitive functions by processing large volumes of data, identifying patterns, making predictions, and continuously improving their performance through experience without being explicitly programmed for every specific task (Kaplan & Haenlein, 2020).

The concept of AI originated in the mid-twentieth century when John McCarthy first introduced the term "Artificial Intelligence" at the Dartmouth Conference in 1956. Since then, AI has evolved significantly due to advances in computing power, data availability, machine

learning algorithms, cloud computing, and big data analytics. Today, AI is regarded as one of the core technologies driving the Fourth and Fifth Industrial Revolutions because of its capacity to automate processes, improve efficiency, and support innovation across virtually every sector of society (Schwab, 2017; UNESCO, 2023).

Artificial Intelligence encompasses several interrelated technologies that enable computers to perform intelligent tasks. These include **machine learning**, which enables systems to learn from data and improve performance over time; **deep learning**, a subset of machine learning that utilizes artificial neural networks to solve complex problems; **natural language processing (NLP)**, which allows machines to understand, interpret, and generate human language; **computer vision**, which enables computers to recognize and analyze images and videos; **robotics**, which integrates AI into automated machines capable of performing physical tasks; and **predictive analytics**, which uses historical data to forecast future events and support decision-making (Russell & Norvig, 2021; Holmes et al., 2022).

In the field of education, Artificial Intelligence has become an important catalyst for transforming teaching, learning, assessment, and educational management. AI-powered educational technologies provide intelligent tutoring systems that offer individualized

instruction, adaptive learning platforms that adjust content according to learners' abilities, automated grading systems that provide immediate feedback, virtual assistants that support learners outside classroom hours, and predictive analytics that identify learners at risk of poor academic performance (Luckin, 2018; Zawacki-Richter et al., 2019). These technologies enable educators to shift from traditional teacher-centred approaches to more learner-centred instructional models that accommodate individual learning differences.

Within adult education, AI is particularly valuable because adult learners possess diverse educational backgrounds, work experiences, learning goals, and time constraints. AI facilitates personalized learning by allowing adults to learn at their own pace, access educational resources anytime and anywhere, receive instant feedback, and engage in self-directed learning experiences that align with the principles of andragogy (Knowles et al., 2020). AI-powered tools such as ChatGPT, Google Gemini, Microsoft Copilot, Grammarly, Duolingo, Canva Magic Design, Quizizz AI, and intelligent learning management systems assist educators in developing instructional materials, simplifying complex concepts, generating assessments, translating content into multiple languages, and supporting collaborative learning environments (Kasneci et al., 2023; Tlili et al., 2023).

Furthermore, AI contributes significantly to educational administration by improving student enrolment processes, attendance monitoring, curriculum planning, learner performance analysis, institutional decision-making, and resource management. Through predictive analytics, educational institutions can identify learning gaps, recommend appropriate interventions, and improve overall educational outcomes (OECD, 2021). However, despite its numerous advantages, the implementation of AI in education requires careful consideration of ethical issues such as data privacy, algorithmic bias, transparency, accountability, and equitable access to digital technologies (UNESCO, 2023).

Overall, Artificial Intelligence represents a transformative innovation that is reshaping educational practice by making teaching more efficient, learning more personalized, assessment more accurate, and educational management more data-driven. Its integration into adult education centres has the potential to enhance lifelong learning opportunities, improve instructional quality, and equip adult learners with the digital competencies required to thrive in an increasingly technology-driven society.

Concept of Adult Education

Adult education is a broad field of education that encompasses all organized learning

activities undertaken by adults after the completion of their initial formal education. It is designed to improve the knowledge, skills, competencies, attitudes, and values of adult learners, enabling them to participate effectively in personal, social, economic, political, and community development. Unlike formal schooling for children and adolescents, adult education is learner-centred, flexible, experience-based, and responsive to the immediate needs and interests of adult learners (Knowles et al., 2020).

The concept of adult education has evolved over the years from a narrow focus on literacy acquisition to a comprehensive approach that promotes lifelong learning, skills development, employability, social inclusion, and sustainable development. UNESCO Institute for Lifelong Learning (UIL, 2022) defines adult education as the entire body of formal, non-formal, and informal learning processes through which adults develop their abilities, enrich their knowledge, improve their technical and professional qualifications, and enhance their participation in society. Similarly, the Recommendation on Adult Learning and Education (RALE) adopted by UNESCO (2015) views adult education as an essential component of lifelong learning that enables adults to continuously acquire competencies necessary for adapting to changing social,

economic, technological, and environmental conditions.

Adult education encompasses a wide range of programmes and learning opportunities, including basic literacy and numeracy education, continuing education, vocational and technical education, entrepreneurship education, community development education, health education, environmental education, civic and citizenship education, digital literacy, professional development, and lifelong learning programmes. These educational activities are delivered through formal institutions, community learning centres, vocational training centres, workplaces, open and distance learning platforms, and increasingly through digital and online environments (Merriam & Bierema, 2014; UNESCO, 2022).

One of the distinguishing characteristics of adult education is its foundation in the principles of **andragogy**, a theory developed by Malcolm Knowles. According to Knowles et al. (2020), adults differ significantly from children in their learning characteristics because they are self-directed, possess a wealth of life experiences, are problem-centred rather than subject-centred, and are motivated to learn when education addresses immediate personal, occupational, or societal needs. Consequently, adult education emphasizes participatory learning, collaborative problem-solving,

experiential learning, critical reflection, and practical application of knowledge rather than rote memorization.

According to UNESCO (2021), adult education is central to achieving the Sustainable Development Goals (SDGs), particularly Goal 4, which seeks to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. Adult learning supports not only individual empowerment but also economic growth, social justice, environmental sustainability, and active citizenship. Similarly, the UNESCO Institute for Lifelong Learning (2022) emphasizes that adult education enhances personal development, social inclusion, employability, democratic participation, cultural understanding, and resilience in rapidly changing societies.

In the contemporary digital age, adult education has expanded beyond conventional classroom instruction to incorporate information and communication technologies (ICT), e-learning platforms, mobile learning, and Artificial Intelligence (AI)-powered educational tools. These innovations provide flexible, personalized, and accessible learning opportunities that accommodate the diverse needs, experiences, and schedules of adult learners. AI technologies, in particular, are transforming adult education by supporting individualized instruction, adaptive learning,

automated assessment, digital content creation, and continuous learner support, thereby making lifelong learning more effective and inclusive (Holmes et al., 2022; Luckin, 2018).

Artificial Intelligence Tools Used in Adult Education Centres

The rapid advancement of Artificial Intelligence (AI) has led to the development of numerous intelligent tools that are transforming instructional delivery, learner engagement, assessment, and educational management. These AI-powered applications support educators in designing learner-centred instructional activities while enabling adult learners to access personalized, flexible, and self-directed learning opportunities. Since adult learners possess diverse educational backgrounds, learning styles, professional responsibilities, and life experiences, AI tools provide adaptive learning environments that accommodate these differences and improve learning outcomes (Holmes et al., 2022; UNESCO, 2023).

The following AI tools are among the most relevant for effective teaching and learning in adult education centres.

1. ChatGPT: ChatGPT, developed by OpenAI, is one of the most widely used generative AI tools in education. It employs advanced natural language processing (NLP) to generate human-

like responses, explain concepts, answer questions, summarize texts, translate languages, and assist with academic writing. In adult education centres, ChatGPT supports lesson planning, instructional content development, assignment preparation, classroom discussions, research assistance, and individualized tutoring. Adult learners can interact with ChatGPT to receive instant explanations, practice language skills, solve mathematical problems, and obtain feedback on written assignments. The tool also promotes self-directed learning by providing educational support beyond classroom hours (Kasneci et al., 2023; Tlili et al., 2023).

2. Google Gemini: Google Gemini is a multimodal AI assistant developed by Google that combines text, images, audio, and code generation capabilities. It assists educators and learners in conducting research, retrieving current information, summarizing complex documents, generating educational content, and supporting collaborative learning. In adult education, Gemini facilitates digital literacy, problem-solving, critical thinking, and project-based learning by enabling learners to explore information from multiple perspectives. It also assists educators in preparing lesson notes, instructional activities, and multimedia learning materials efficiently (Google, 2024; UNESCO, 2023).

3. Microsoft Copilot: Microsoft Copilot integrates AI capabilities into Microsoft 365 applications such as Word, Excel, PowerPoint, Outlook, and Teams. It improves educator productivity by generating lesson plans, drafting reports, creating presentations, analyzing learner performance data, automating spreadsheets, and summarizing meeting discussions. Adult education facilitators can use Copilot to prepare instructional materials, monitor learners' progress, organize administrative records, and communicate effectively with learners. The integration of AI into familiar productivity software reduces workload and enhances institutional efficiency (Microsoft, 2024).

4. Grammarly AI: Grammarly AI is an intelligent writing assistant that improves grammar, punctuation, spelling, vocabulary, clarity, tone, and writing style. Beyond correcting grammatical errors, it provides suggestions for sentence restructuring, academic writing, plagiarism detection, and citation support. In adult education centres, Grammarly assists learners in developing effective communication skills, preparing assignments, writing reports, and improving professional correspondence. It is particularly useful for adult learners who are improving their literacy, academic writing, or workplace communication skills (Grammarly, 2024).

5. Canva AI: Canva AI incorporates generative AI features such as Magic Design, Magic Write, Text-to-Image, and AI-powered presentation tools that simplify instructional material development. Educators can quickly create presentations, posters, certificates, flyers, infographics, lesson illustrations, and educational videos without requiring advanced graphic design skills. In adult education centres, Canva AI enhances visual learning, learner engagement, creativity, and instructional effectiveness by making educational content more attractive and easier to understand (Canva, 2024).

6. Duolingo AI: Duolingo employs Artificial Intelligence and adaptive learning algorithms to provide personalized language instruction. The platform continuously analyzes learners' progress and adjusts lesson difficulty according to individual performance. Adult learners receive immediate feedback, personalized practice exercises, pronunciation support, and gamified learning experiences that enhance motivation and language retention. This makes Duolingo particularly valuable for literacy programmes, second-language acquisition, and workplace communication training in adult education centres (Loewen et al., 2019).

Roles of AI Tools in Effective Teaching and Learning

Artificial Intelligence (AI) has become an indispensable component of modern educational practice by enhancing instructional delivery, improving learning experiences, and increasing the efficiency of educational management. In adult education centres, where learners possess diverse educational backgrounds, work experiences, learning needs, and time commitments, AI tools provide flexible, personalized, and learner-centred instructional support. The integration of AI enables educators to adopt innovative teaching strategies while empowering adult learners to engage in lifelong, self-directed, and competency-based learning (Holmes et al., 2022; UNESCO, 2023). The major roles of AI tools in effective teaching and learning are discussed below.

Personalized Learning

One of the most significant contributions of AI is its ability to personalize learning experiences according to individual learners' needs, interests, abilities, and learning pace. AI-powered adaptive learning systems continuously monitor learners' progress, identify strengths and weaknesses, and recommend learning materials that match their current level of understanding. This individualized approach enables adult learners to progress at their own pace without the pressure of competing with others in a classroom setting. Personalized learning also

enhances learner confidence, motivation, retention, and academic achievement by ensuring that instructional content remains relevant and appropriately challenging (Luckin, 2018; Zawacki-Richter et al., 2019).

Intelligent Tutoring

AI-powered intelligent tutoring systems function as virtual learning assistants that provide individualized guidance, explanations, and academic support beyond regular classroom hours. These systems answer learners' questions, explain difficult concepts, provide practice exercises, and offer immediate feedback whenever assistance is needed. Unlike conventional classroom instruction, intelligent tutors are available twenty-four hours a day, allowing adult learners—many of whom combine education with work and family responsibilities—to study conveniently at their preferred time and pace. AI tutors therefore complement the role of educators by extending learning opportunities beyond the physical classroom (Holmes et al., 2022; Kasneci et al., 2023).

Automated Assessment and Immediate Feedback

AI significantly improves the assessment process by automating the grading of quizzes, assignments, objective tests, and other learning activities. Automated assessment systems

provide immediate feedback that helps learners identify mistakes and improve their understanding before progressing to subsequent learning tasks. For educators, AI reduces the time spent on repetitive grading activities, enabling them to devote more attention to learner support, mentoring, curriculum improvement, and instructional innovation. Furthermore, AI-generated performance analytics help educators identify learning gaps and implement timely interventions to improve academic outcomes (UNESCO, 2023; OECD, 2021).

Enhanced Learner Engagement

AI technologies promote active learner participation through interactive learning environments, educational games, simulations, virtual laboratories, chatbots, augmented reality (AR), and virtual reality (VR) applications. These technologies transform passive learning into engaging and collaborative experiences that sustain learners' interest throughout the instructional process. Gamified learning platforms reward progress through points, badges, quizzes, and competitions, thereby increasing learner motivation and participation. For adult learners, whose attendance may be affected by occupational and family commitments, these engaging instructional strategies encourage persistence and continuous participation in learning programmes (Holmes et al., 2022).

Curriculum Development and Instructional Material Preparation

AI assists educators in designing, developing, and organizing instructional materials that align with curriculum objectives and learners' needs. AI-powered applications generate lesson plans, presentation slides, instructional notes, practice exercises, case studies, visual illustrations, and multimedia content within a short period. Educators can also use AI to update instructional materials with current information, adapt content for different learner groups, and translate educational resources into multiple languages. Consequently, AI enhances the quality, relevance, and efficiency of curriculum implementation in adult education centres (Tlili et al., 2023).

Research Support

AI has become an important research assistant for educators, researchers, and adult learners. AI-powered research tools help users identify relevant literature, summarize scholarly articles, organize references, generate citations, synthesize research findings, and develop research questions. They also assist in proofreading academic manuscripts, improving writing quality, detecting grammatical errors, and organizing research data. These capabilities significantly reduce the time required for literature review and academic writing while improving research productivity

and scholarly communication. However, researchers are expected to verify AI-generated information and adhere to ethical standards regarding academic integrity and proper citation (Kasneci et al., 2023; UNESCO, 2023).

Digital Inclusion and Accessibility

Artificial Intelligence promotes inclusive education by providing assistive technologies that support learners with disabilities and diverse learning needs. Speech-to-text software, text-to-speech applications, real-time captioning, language translation tools, screen readers, voice assistants, and adaptive interfaces enable visually impaired, hearing-impaired, physically challenged, and linguistically diverse learners to participate fully in educational activities. These accessibility features reduce educational barriers and ensure equitable learning opportunities for all learners regardless of physical ability, language, or educational background. In adult education centres, where learners often come from diverse socio-economic and educational contexts, AI plays an essential role in fostering inclusion and educational equity (UNESCO, 2023).

Promotion of Lifelong and Self-Directed Learning

AI supports the philosophy of lifelong learning by providing learners with continuous access to

educational resources regardless of time or location. Adult learners can engage with AI-powered platforms to acquire new knowledge, update professional skills, and pursue personal development throughout their lives. AI encourages self-directed learning by allowing learners to determine their learning goals, select appropriate resources, monitor their progress, and receive personalized recommendations. This flexibility is particularly beneficial to adults who must balance education with employment, entrepreneurship, and family responsibilities (Knowles et al., 2020; UNESCO Institute for Lifelong Learning, 2022).

Strategies for Effective AI Integration in Adult Education Centres

Improve ICT Infrastructure

The availability of reliable Information and Communication Technology (ICT) infrastructure is fundamental to the successful adoption of AI in education. Adult education centres should be equipped with adequate computers, interactive smart boards, digital projectors, servers, and modern learning management systems. Equally important are reliable electricity supply, high-speed internet connectivity, cloud computing facilities, and secure digital storage systems. In many developing countries, particularly Nigeria, inadequate ICT infrastructure remains one of

the greatest barriers to AI adoption. Governments and educational institutions should therefore prioritize investments in digital infrastructure to create technology-enabled learning environments that support AI-powered teaching and learning (UNESCO, 2023).

Provide Regular AI Training for Facilitators

The effectiveness of AI tools largely depends on the competence of educators who utilize them. Adult education facilitators require continuous professional development programmes to acquire the knowledge and skills necessary for integrating AI into instructional practice. Training should cover the operation of AI-powered educational tools, prompt engineering, digital content creation, adaptive learning systems, automated assessment, ethical AI use, and digital classroom management. Continuous capacity building will improve educators' confidence, reduce resistance to technological change, and enable them to use AI to complement rather than replace effective teaching practices (Holmes et al., 2022).

accountability, consistency, and transparency in AI implementation (UNESCO, 2023). Promote Digital Literacy among Adult Learners

Digital literacy is a prerequisite for the effective utilization of AI technologies. Adult learners should be equipped with essential digital competencies, including basic computer operation, internet navigation, online communication, digital information management, cybersecurity awareness, and responsible AI usage. Digital literacy programmes should also develop learners' ability to critically evaluate AI-generated information, verify facts, recognize misinformation, and apply AI ethically in academic and professional settings. Improving digital literacy enhances learners' confidence, independence, and ability to participate effectively in technology-driven learning environments (UNESCO Institute for Lifelong Learning, 2022).

Encourage Blended Learning Approaches

Rather than replacing conventional teaching methods, AI should be integrated through blended learning approaches that combine face-to-face instruction with online and AI-supported learning activities. Blended learning allows educators to maintain meaningful human interaction while leveraging AI for personalized learning, independent study, formative assessment, and learner support. Adult learners benefit from the flexibility of accessing instructional materials at their convenience while still receiving guidance, mentorship, and collaborative learning

opportunities from facilitators and peers. This balanced approach maximizes the strengths of both traditional and technology-enhanced instruction (Graham, 2019).

Continuously Monitor and Evaluate AI Implementation

The successful integration of AI requires continuous monitoring and evaluation to determine its effectiveness, efficiency, and impact on teaching and learning. Educational institutions should establish performance indicators that assess learner achievement, engagement, digital competency development, educator satisfaction, instructional quality, and institutional efficiency. Regular feedback from educators, learners, and administrators should inform improvements in AI implementation. Continuous evaluation also enables institutions to identify emerging challenges, update implementation strategies, and ensure that AI technologies remain aligned with educational goals and learners' evolving needs (Holmes et al., 2022).

Conclusion

Artificial Intelligence (AI) has become a transformative tool for enhancing teaching and learning in adult education centres. Its application through tools such as ChatGPT, Google Gemini, Microsoft Copilot, Grammarly AI, Canva AI, and other intelligent platforms

supports personalized learning, intelligent tutoring, automated assessment, learner engagement, research, and efficient educational management. These innovations align with the principles of adult education by promoting flexible, learner-centred, and lifelong learning experiences.

Despite its enormous potential, the effective integration of AI in adult education is constrained by challenges such as inadequate ICT infrastructure, limited digital literacy, poor internet connectivity, insufficient funding, and the absence of clear institutional policies, particularly in developing countries. Therefore, governments and educational institutions must invest in digital infrastructure, capacity building, supportive policies, and

AI should be regarded as a complementary tool that enhances, rather than replaces, the role of educators. Its effective integration will improve the quality, accessibility, and inclusiveness of adult education programmes, thereby promoting lifelong learning and contributing to sustainable educational and national development.

Recommendations

1. Government should provide reliable digital infrastructure and stable electricity to adult education centres.

2. Adult educators should receive continuous professional development on AI applications in teaching and learning.
3. Adult education curricula should integrate AI and digital literacy competencies.
4. Institutions should establish ethical guidelines governing AI use, including data privacy and academic integrity.
5. Public-private partnerships should be strengthened to provide affordable AI tools and internet access.
6. Adult learners should be encouraged to use AI responsibly to support, rather than replace, critical thinking and independent learning.
7. Researchers should undertake empirical studies on the impact of AI tools on adult learners' achievement, engagement, and skill acquisition in Nigeria

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