LEVERAGING ARTIFICIAL INTELLIGENCE TO TRANSFORM ADULT LEARNING AND EDUCATION FOR HUMAN DEVELOPMENT AND EMPOWERMENT

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Abstract

This study explores the transformative potential of Artificial Intelligence (AI) in adult learning and education, with a focus on fostering human development and empowerment. As educational needs evolve and access remains unequal—particularly in regions like Nigeria—AI presents innovative solutions to improve the quality, accessibility, and personalisation of adult education. The paper examines key adult learning theories, including transformative and self-directed learning, to understand how AI technologies can align with or enhance these pedagogical foundations. Findings from the literature review highlight that AI-driven platforms can deliver personalised learning experiences tailored to individual learner needs, thereby supporting autonomy and lifelong learning. AI also plays a pivotal role in democratising education by reaching underserved populations, reducing costs, and offering flexible, on-demand access to resources through virtual assistants, adaptive systems, and mobile platforms. Additionally, AI facilitates collaborative learning environments through intelligent tutoring systems, chatbots, and virtual classrooms that foster social interaction and peer engagement. However, the integration of AI in adult education faces significant challenges, including institutional resistance, limited infrastructure, lack of educator training, and ethical concerns related to data privacy and algorithmic bias. The study recommends a human-centred approach to AI implementation that prioritises inclusivity, ethical standards, and professional development for educators. Investments in digital infrastructure and equitable access to AI tools are also critical. Furthermore, continued research is necessary to explore AI's capacity to support creativity, empathy, and critical thinking in adult education. In conclusion, AI should be seen not merely as a technical innovation but as a catalyst for reimagining adult education to be more inclusive, adaptive, and empowering in the pursuit of lifelong learning.

Keywords: Artificial Intelligence, Adult Learning, Human Development, Empowerment, Personalized Learning, Collaborative Learning.

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Introduction

The fast development of artificial intelligence (AI) brings revolutionary changes to industry sectors while education suffers the most substantial transformation. AI technology in adult education brings unmatched opportunities to advance both learning quality and educational accessibility and individual and career growth. Nigeria has faced multiple obstacles in adult education since antiquity because adult learners cannot access education well and the teaching methods are old and there are insufficient resources. The existing obstacles limit adult learners from attaining necessary skills which would enhance their socio-economic growth. Implementing AI-driven innovations enables the solution of current barriers to adult education while enhancing its effectiveness which leads to better human development results. AI helps create individualized courses and operates administrative processes while

introducing teaching approaches that meet various requirements of adult learners. This paper evaluates AI potential to transform adult learning and education systems as tools for human growth and empowerment.

The history of adult education in Nigeria revolves around teaching critical thinking skills and promoting ongoing education to empower people for community engagement. Organizations implementing adult education have confronted limitations because outdated teaching approaches and excessive rote learning continue to dominate classrooms according to Odey and Alabi (2021). Students at the adult learning stage find themselves challenged by teaching approaches that use inflexible educational programs which neglect individual requirements. Traditional educational delivery formats including face-to-face lectures with textbooks prove ineffective for effective learner interaction because people today need digital literacies. The informal nature of adult learners' accessibility presents a big hurdle particularly when these learners reside in rural areas combined with work obligations making it difficult to complete their studies. The technological advancement of AI functions as a solution for resolving these difficulties because it generates customizable adaptive learning approaches that welcome all students equally.

Adult education practice in Nigeria faces a significant obstacle due to the shortage of efficient teaching approaches. Multiple educational programs keep employing passive lecturing while failing to engage students through adaptable educational methods (Eze et al., 2022) AI systems through software like intelligent tutors and adaptive learning platforms match educational content with the specific requirements of each student. Learning systems equipped with algorithms give learners tailored instruction by modifying instructional materials based on testing each student's academic achievements. Adult education gains from AI integration by delivering personalized advice and enabling students to source on-demand materials and engage with interactive simulation exercises through which knowledge absorption improves.

Current delivery methods of adult education in Nigeria require improvement in order to boost accessibility and improve educational effectiveness for adults. The duty demands of adult learners create obstacles to their participation in traditional classroom education because they cannot maintain regular attendance at scheduled sessions. AI-based education platforms that comprise virtual learning assistants and chatbots alongside online learning platforms make learning accessible to adults who can study based on their preferred pace and time (Ajibola & Ogunyemi, 2020). AI-based voice recognition solutions along with translation capabilities through voice recognition systems improve educating by helping people understand languages better even in multilingual environments such as Nigeria. The data processing capabilities of AI analytics technology enable instructors to find knowledge gaps between students so they can establish specific solutions to enhance learning success.

The current adult education system of Nigeria faces serious challenges because its structured adult education programs are scarce. The current adult education initiatives in Nigeria suffer from insufficient funding together with obsolete technological infrastructure that fails to meet modern labor market requirements (Salami & Adeyemi, 2021). New educational programs based on skill development and entrepreneurship alongside digital literacy may receive support from artificial intelligence to design and put into practice. Learning management systems enabled by AI allow institutions to deliver inexpensive courses which supply precise immediate student feedback together with interactive teaching programs coupled with better

learner evaluation systems. AI enables the incorporation of virtual apprenticeships into vocational training lessons that let students practice industrial skills for diverse sectors.

AI holds great potential for Nigerian adult education development yet its execution demands careful consideration because it involves handling concerns regarding ethical matters and data safety along with preventing inequality amplification. A commitment to fair learning tool access must include digital infrastructure growth plus teacher skill development support together with education measures that emphasize inclusion. AI technology serves best as a resource for humans teaching staff because it enables both educational continuity and learner-centered methods as well as critical thinking abilities and creativity together with social connection. The education sector stakeholders of Nigeria need to team up and build protocols that will enable the proper implementation of AI in adult learning systems as AI technology progresses.

AI serves as a transformative solution to enhance Nigerian adult education because it resolves three vital obstacles related to teaching methods and distribution platforms and training opportunities accessibility. Artificial intelligence solutions enable adult learners to experience adapated learning environments with flexible delivery methods which leads to skills advancement and social-economic benefits. The implementation of AI in education needs strict planning to achieve both inclusivity and sustainability goals. This paper examines current research on the combination of artificial intelligence and adult education to evaluate potential improvements of learning experiences and potential humanization effects in educational settings. The progress of AI demands thorough analysis of its effects on adult learners because this knowledge helps sustain educational methods based on learning diversity and inclusion.. This article has three objectives: first, to examine the theoretical underpinnings of adult learning and the integration of AI to augment these principles; second, to assess the ramifications of AI-driven personalised learning on the experiences of adult learners; and third, to investigate the ethical considerations and obstacles associated with the implementation of AI in adult education

Methodology

This study utilises a literature review technique, concentrating on secondary research to examine the transformational potential of artificial intelligence (AI) in adult education and learning. The evaluation process started with an exhaustive search of academic databases, such as Google Scholar, JSTOR, and ERIC, to locate pertinent peer-reviewed papers, books, and reports produced in the last twenty years. The selection criteria concentrated on research that particularly examined the use of AI in adult education, highlighting themes such as personalised learning, accessibility, cooperation, and ethical implications. This review synthesises results from several sources to provide a comprehensive picture of AI's influence on adult education and human development.

Thematic analysis was used to categorise and assess the principal results in the literature synthesis. This method enabled the discovery of repeating themes and patterns, allowing for the examination of the impact of AI technology on numerous facets of adult learning. The study emphasises the benefits and problems posed by AI, including several views for a comprehensive analysis of the subject. This study aims to enhance the conversation on AI in education via secondary research, offering insights that may guide future research and practices in adult learning and education.

Theoretical Foundations of Adult Learning and Human Development in the Age of AI

The incorporation of Artificial Intelligence (AI) in adult education necessitates a robust theoretical comprehension of adult learning and development, especially concerning the transformational capabilities of technology. Theories of adult learning, including transformational learning and self-directed learning, give essential insights into the dynamics of adult education and provide a framework for comprehending how AI may augment or, in some cases, contest conventional learning models. Transformative learning theory, created by Jack Mezirow, is fundamental to adult education, asserting that adults acquire knowledge via experiences that confront their existing viewpoints, resulting in a shift in their worldview (Mezirow, 1997). The convergence of this theory with AI pertains to the manner in which technology might enable transformational experiences. Artificial intelligence has the capacity to augment transformational learning by offering adaptive learning environments that engage adult learners via tailored feedback, data-informed insights, and immersive simulations. AI-driven platforms may provide virtual settings that replicate real-life scenarios, enabling learners to participate in problem-solving tasks that stimulate critical reflection and shift perspectives (Yang et al., 2020). These experiences correspond with Mezirow's claim that transformational learning occurs when learners encounter confusing situations, prompting them to reevaluate their preconceptions.

Nonetheless, the use of AI in transformational learning presents specific obstacles. AI systems often function according to pre-established algorithms, which may constrain the unpredictability and creativity essential for transformational learning. Furthermore, opponents contend that AI-driven educational models may emphasise efficiency and uniform results at the expense of the profound, introspective thinking that transformational learning aims to foster (Selwyn, 2019). Consequently, while AI has the capacity to enhance transformational learning, its implementation must be carefully crafted to prevent the reduction of education to a solely mechanical process.

Self-directed learning (SDL), a major principle in adult education, asserts that people assume responsibility for their learning processes by proactively seeking resources, establishing objectives, and evaluating their progress (Knowles, 1975). Artificial intelligence may substantially improve self-directed learning by providing customised learning trajectories aligned with individual requirements and preferences. AI-driven solutions enable learners to access information tailored to their own speed and style, get immediate feedback, and independently monitor their progress. Research indicates that educational AI systems, including intelligent tutoring systems and learning management platforms, may enhance learner autonomy by enabling adults to oversee their own educational paths (Yin et al., 2021). These systems provide learners with a diverse range of materials, allowing them to investigate subjects thoroughly based on their interests and learning styles, thereby reinforcing the fundamental tenets of self-directed learning (SDL).

Nonetheless, the convergence of AI with self-directed learning presents some challenges. Although AI may enhance educational experiences via customisation, there exists a danger of excessive dependence on technology, thereby diminishing the intrinsic desire essential for autonomous learning. Knowles (1975) said that self-directed learning encompasses more than mere resource availability; it requires the development of self-discipline, motivation, and critical thinking skills. If AI systems are not developed with these considerations, they may unintentionally promote passive learning behaviours, causing learners to depend excessively

on the system for guidance instead of actively participating in their own education (Johnson, 2022).

From a humanistic standpoint, education is seen as a process that fosters personal progress, self-actualization, and the realisation of individual potential (Rogers, 1983). Humanistic education emphasises the emotional and psychological needs of the learner, prioritising empathy, creativity, and the cultivation of significant connections between learners and educators. The incorporation of AI into this paradigm prompts significant enquiries on technology's role in promoting or obstructing humanistic ideals. AI may enhance humanistic education by delivering personalised learning experiences tailored to individual emotional and cognitive requirements. AI systems may evaluate a learner's progress and emotional involvement, providing constructive feedback that corresponds with their unique learning trajectory, so fostering a more personalised and compassionate educational experience (Baker & Smith, 2019).

Nonetheless, there are apprehensions that AI might undermine the humanistic concept by depersonalising education and turning students to just data points inside an algorithm. The concern is that AI-driven educational systems may emphasise efficiency and standardisation at the expense of the social and emotional aspects of learning that are fundamental to humanistic education (Zawacki-Richter et al., 2019). The lack of a human instructor in AI-mediated learning settings may compromise the relational dimension of education, which is essential for cultivating empathy, trust, and emotional intelligence—skills vital for human growth. Consequently, while AI may improve the personalisation of educational experiences, it is essential to reconcile technical efficiency with the humanistic objective of cultivating deep, meaningful connections between learners and educators.

In summary, the theoretical underpinnings of adult learning, including transformational learning, self-directed learning, and humanistic education, provide significant insights into how AI might both augment and contest conventional frameworks of adult education. AI has the capacity to provide transformational and autonomous learning via personalised, adaptable educational settings; nevertheless, it also introduces issues with standardisation, passive learning, and depersonalisation. A meticulous and equitable strategy is essential to guarantee that AI enhances rather than detracts from the humanistic principles fundamental to adult education and human development

AI-Powered Personalized Learning in Adult Education

Artificial intelligence (AI) has become a transformational instrument in the educational industry, especially in adult learning. Personalised learning, which customises educational material and delivery methods to meet individual student requirements, has been substantially improved by AI technology. Conventional uniform educational methods often fail to accommodate the varied demands, experiences, and learning velocities of adult learners. AI systems in adult education operate by gathering and analysing extensive data on learners' performance, behaviour, and preferences. AI can discern patterns in data using machine learning algorithms, enabling the customisation of learning paths. Adaptive learning platforms modify task difficulty according to a learner's performance, ensuring that learners are neither overwhelmed nor alienated by information that is too simple or challenging (Zawacki-Richter et al., 2019). This strategy is especially beneficial in adult education because of the diverse degrees of previous knowledge, abilities, and experiences that adult learners possess, which might affect their learning paths. By adjusting the tempo and

substance of teaching, AI enables each student to advance at their own rate, fostering a more effective and gratifying educational experience.

A significant benefit of AI-driven personalised learning is its capacity to promote student autonomy. Autonomy is a fundamental aspect of adult education, as underscored by Knowles' theory of andragogy, which asserts that adults are self-directed learners (Knowles, 1980). Artificial intelligence solutions, such intelligent teaching systems and personalised dashboards, enable learners to take responsibility for their education by offering real-time feedback and suggestions. These systems may also recommend supplementary materials, such as books or activities, that correspond with the learner's interests or areas of difficulty. This degree of customisation facilitates a more self-directed learning process, enabling adult learners to establish their own objectives, track their progress, and make informed choices about their educational trajectories (Holmes et al., 2019). Furthermore, this tailored assistance helps alleviate the frustration and disengagement that can occur when learners struggle to keep up with a standardised curriculum or are compelled to revisit content they have previously learnt.

AI's use in instructional design significantly improves personalised learning experiences. AI-driven instructional design utilises algorithms to create and enhance educational resources tailored to the distinct requirements of individual learners. Luckin et al. (2016) assert that AI can facilitate the creation of courses that are adaptable and dynamic, modifying both the content and the distribution method. For instance, some learners may get more advantage from visual aids, whilst others could like text-based or interactive resources. AI systems may evaluate a learner's engagement with diverse content kinds and then prioritise the materials that are most beneficial for that person. This flexibility is particularly important for adult learners, who may possess diverse cognitive processes and differing levels of technological proficiency, necessitating a more customised approach to instructional design.

AI have the capacity to dramatically improve adult learning experiences by ensuring the information remains relevant and engaging. Adult learners, often balancing job, family, and other obligations, are more inclined to remain engaged when they see the information as directly relevant to their personal or professional objectives (Merriam & Bierema, 2014). The capacity of AI to perpetually modify the curriculum according to the learner's changing requirements guarantees that the content stays linked with their goals, therefore enhancing both relevance and motivation. Moreover, AI-driven systems often include gamification and interactive components, enhancing the enjoyment and engagement of the learning experience. Virtual simulations or scenario-based learning may immerse adult learners in realistic scenarios, allowing them to apply new skills in a risk-free environment, hence boosting engagement and retention (Woolf, 2020).

Nonetheless, while AI has significant promise for improving personalised learning in adult education, there are problems that must be addressed. A primary problem is the possible over-dependence on technology, which may undermine the function of human instructors. Although AI systems may provide personalised assistance and feedback, they are incapable of entirely emulating the human aspects of teaching, like empathy, encouragement, and the facilitation of group conversations or critical thinking. Zawacki-Richter et al. (2019) assert that the optimal use of AI in education necessitates a balance between technology and human contact, positioning AI as a tool to augment, rather than replace, the function of educators.

Moreover, concerns about data privacy and the ethical use of AI in education must not be disregarded. Personalised learning systems depend on the accumulation and examination of personal data, prompting apprehensions over the storage, utilisation, and safeguarding of this information. Adult learners, notably, may be more sensitive to privacy concerns, especially when pursuing education for professional growth or career progression. Consequently, open rules and practices concerning data security are vital for establishing confidence in AI-driven learning systems (Holmes et al., 2019).

In summary, AI-driven personalised learning profoundly impacts adult education by offering adaptive learning experiences tailored to individual requirements, fostering learner autonomy, and increasing engagement. AI's capacity to customise material and instructional design to align with the distinct preferences and skills of adult learners signifies a significant departure from conventional educational frameworks. Nonetheless, while the prospective advantages are considerable, it is important to approach the incorporation of AI in adult education with deliberation, ensuring that ethical issues and the fundamental human elements of teaching are not neglected. The future of adult education depends on a synergistic collaboration between AI and human instructors, whereby technology enhances educational accessibility while maintaining its essential humanistic qualities.

Artificial Intelligence and the Democratization of Adult Education

Artificial Intelligence (AI) has the capacity to substantially democratise adult education by broadening access to educational opportunities, especially for marginalised and underprivileged groups. The flexibility, scalability, and adaptability of AI may revolutionise conventional educational settings, enhancing accessibility, inclusivity, and equity in education. AI-driven platforms are transforming adult education by providing personalised learning experiences suited to the distinct requirements of individual learners. These platforms may analyse data from many sources to develop tailored learning pathways that adapt to learners' speed, skill level, and learning style (Baker & Smith, 2019). This adaptability enables marginalised groups, such those in isolated rural regions or full-time employed people unable to participate in conventional classrooms, to access educational materials at their leisure. AI systems may provide educational resources in several formats—text, audio, video, or interactive simulations—ensuring accessibility for learners with diverse skills and preferences.

AI significantly enhances access to adult education by decreasing expenses. Conventional education sometimes necessitates considerable financial resources, including tuition, transportation, and physical materials, which may be restrictive for those from low-income families. AI may substantially diminish these expenses by automating certain facets of training and evaluation, hence lessening the need for costly physical infrastructure. AI-driven tutoring solutions may provide students prompt feedback and tailored assistance without the continuous involvement of a human teacher (Luckin et al., 2016). The extensive availability of AI-enhanced open educational resources (OER) enables learners to get high-quality instructional materials at little or no cost, hence reducing financial obstacles to education.

AI is crucial in surmounting geographical obstacles that have historically limited educational access. Access to educational institutions is restricted in several areas globally, especially in rural or conflict-affected countries. AI-driven educational systems, often available via mobile devices, provide superior instruction to students irrespective of their geographical location (Tuomi, 2020). Mobile AI apps may provide offline functionalities, enabling learners without

consistent internet connectivity to download educational resources and study at their own speed. This modality of "anytime, anywhere" learning is essential for guaranteeing that persons in remote or underprivileged locations possess equal educational chances as those in more urbanised or rich regions.

Moreover, AI may augment inclusion in adult education by offering assistance to learners with impairments. Artificial intelligence technologies, including voice recognition, text-to-speech systems, and adaptive learning algorithms, enhance the accessibility of instructional material for persons with visual, aural, or cognitive impairments (Baker et al., 2019). AI-driven systems may transform text into audio for visually challenged students or provide real-time captioning for those with hearing impairments. These technologies facilitate the establishment of a more inclusive educational environment, guaranteeing that adult education is accessible to everyone, irrespective of physical or cognitive constraints. Although AI offers considerable prospects for enhancing educational access, digital inclusion methods are crucial to guarantee equitable distribution of these possibilities. Digital inclusion encompasses initiatives designed to guarantee that all persons, especially those from marginalised populations, possess access to digital technology and the competencies to use them proficiently (Selwyn, 2021). In the absence of intentional initiatives to foster digital inclusion, the advantages of AI in education may exacerbate existing inequalities, since access to AI-enhanced educational resources often necessitates digital literacy and dependable internet connection.

Mitigating the digital gap is essential for harnessing AI's capacity to democratise education. Numerous marginalised people, especially in low-income nations, continue to be deprived of fundamental digital infrastructure. The International Telecommunication Union (2020) reports that approximately half of the world population is still offline, mostly in rural and isolated areas. Digital inclusion policies should prioritise the expansion of broadband connection, especially in underdeveloped regions, while also facilitating inexpensive access to devices like smartphones and tablets. Governments, international organisations, and the business sector must collaborate to bridge this gap via infrastructural development and subsidised technological initiatives.

A crucial element of digital inclusion pertains to enhancing digital literacy among adult learners. Despite access to technology, many people lack the requisite abilities to interact successfully with AI-enhanced educational systems. Initiatives aimed at enhancing digital literacy, which include instruction in fundamental computer skills, internet navigation, and the utilisation of AI-driven technologies, are crucial for enabling marginalised people to fully use AI's educational capabilities (Selwyn, 2021). These programs must be customised to address the distinct requirements of various demographics, including older folks and those with less previous experience with digital technology, to guarantee inclusion.

AI has the revolutionary capacity to democratise adult education by enhancing access to learning opportunities for marginalised and under-represented groups. Nonetheless, actualising this promise requires comprehensive digital inclusion policies that tackle inequalities in access to technology and digital competencies. By systematically enhancing digital infrastructure, facilitating inexpensive technology access, and advancing digital literacy, AI may function as a potent instrument for making education more accessible, egalitarian, and inclusive. In this manner, AI may facilitate human growth and empowerment, fostering a more equitable and informed society.

Ethical Considerations in the Integration of AI in Adult Learning

The use of artificial intelligence (AI) in adult education shows significant promise, although it also introduces several ethical dilemmas, especially around data privacy, surveillance, and prejudice in AI-driven educational technology. The use of AI systems to enhance personalised and adaptive learning experiences has resulted in a substantial accumulation of data from adult learners. This data, often including personal information such as learning preferences, performance indicators, and demographic characteristics, presents considerable privacy hazards. The issue originates from the reliance of several AI systems on extensive data for optimal performance, which might unintentionally subject learners to privacy violations or exploitation. Moreover, adult learners, particularly those from marginalised backgrounds, may lack awareness about the collection, storage, or use of their data, hence prompting concerns about informed consent in AI-mediated education (Bates, 2019).

Data privacy is closely associated with monitoring, another ethical dilemma in AI-driven education. As AI systems constantly assess student progress to provide feedback and modifications, the distinction between advantageous educational monitoring and intrusive surveillance becomes ambiguous. AI-driven educational systems may monitor learners' keystrokes, facial expressions, and emotions using advanced biometric technologies. Although these features intend to enhance the learning experience, they may also foster a culture of perpetual surveillance, whereby learners could feel compelled to adhere to certain norms or behaviours owing to the omnipresent scrutiny of AI systems. This may result in less autonomy and hinder the genuine articulation of thoughts and ideas, which is essential for adult learning (Eynon & Malmberg, 2021).

In addition to privacy and surveillance issues, prejudice in AI systems is another critical ethical challenge that requires thorough examination. AI systems are constructed using algorithms trained on extensive datasets, and if these datasets exhibit prejudices—either via the under-representation of certain groups or through historical biases inherent in the data—the AI system may perpetuate or exacerbate these biases. In adult education, this may lead to prejudiced suggestions for courses, evaluations, or learning trajectories that disadvantage certain demographic groups, especially racial and ethnic minorities or those from poorer socioeconomic backgrounds (Adamson et al., 2022). If an AI system is trained on data that mostly represents the learning behaviours and results of white, middle-class individuals, it may be less successful or even biassed for learners from other backgrounds. This may result in disparate learning experiences, compromising the tenet of educational equality.

To address these ethical problems, there is an increasing need for the development and application of human-centric AI methodologies in adult education. Human-centric AI emphasises the welfare, autonomy, and rights of learners, guaranteeing that AI systems are developed and implemented to augment, rather than diminish, the human learning experience. The notion of transparency is fundamental to this strategy. Educational institutions and producers of AI-driven learning platforms must disclose the operational mechanisms of AI systems, the methods of data collection and utilisation, and the possible hazards involved. Transparency cultivates trust and enables learners to make educated choices about their involvement in AI-enhanced educational initiatives (Floridi & Cowls, 2019).

Furthermore, human-centric AI underscores the need of preserving learner autonomy. AI systems in adult education have to be structured to empower learners in determining their own educational trajectories, rather than imposing learning pathways simply based on

algorithmic forecasts. This entails integrating components of learner feedback, adaptation, and self-regulation into AI systems, so guaranteeing that the student stays central to the educational process. In this setting, AI serves as a facilitator or instrument, enabling learners to assume control of their education while receiving personalised help (Zawacki-Richter et al., 2019).

A vital component of human-centric AI is the need to protect the rights of learners. This encompasses both data privacy rights and the right to non-discrimination. AI system developers must diligently uncover and eradicate biases in algorithms to guarantee fair and equitable treatment of all learners. This may be accomplished by systematic audits of AI systems, the utilisation of varied and representative datasets, and the use of fairness algorithms that mitigate any biases. By emphasising justice and equality, human-centric AI guarantees that AI-driven education does not perpetuate current social disparities but instead functions as an instrument for empowerment and inclusion (Adamson et al., 2022).

The Role of AI in Facilitating Collaborative Learning and Social Interaction

Artificial intelligence (AI) is significantly transforming adult education, especially in enhancing collaborative learning and social interaction. In a period of rapid technological advancement, AI-driven tools such as chatbots, virtual classrooms, and intelligent tutoring systems (ITS) are progressively being incorporated into educational settings, providing novel opportunities for peer interaction, mentorship, and the establishment of learning communities. These technologies are not only improving learning efficiency but also transforming the interactions among adult learners, their instructors, and educational materials.

AI-driven chatbots have become a notable advancement in collaborative learning by offering immediate assistance, promoting dialogue, and addressing enquiries in educational environments. Chatbots, using natural language processing (NLP) algorithms, provide effortless communication among learners, instructors, and content platforms, hence enhancing active participation (Guan et al., 2023). In adult learning contexts, where individuals often balance schooling with employment and other obligations, the availability and adaptability of chatbots may cultivate a perception of ongoing assistance. Moreover, chatbots augment peer-to-peer cooperation by starting and moderating conversations, addressing routine enquiries, and supporting group activities, hence fostering a dynamic and engaging learning environment (Chen & Hong, 2022). This degree of contact fosters learner autonomy while also facilitating collaborative problem-solving and information exchange among adult learners.

Virtual classrooms, an essential AI-driven resource, enable adult learners to engage in a digitally augmented educational experience that replicates traditional classroom environments. These systems are designed to integrate many AI-driven functionalities, including voice recognition, real-time feedback, and adaptive learning environments, facilitating both synchronous and asynchronous learning modalities (Zawacki-Richter et al., 2019). In virtual classrooms, adult learners may work on group projects, engage in debates, and participate in activities that replicate in-person interactions. The use of AI in administering virtual learning environments also include the promotion of social interaction. Intelligent systems may assess involvement levels and provide suggestions for group collaborations based on learners' performance and preferences (Hung & Zhang, 2020). This

not only improves peer interaction but also fosters the establishment of learning communities where learners facilitate one other's development, therefore enriching the entire educational experience.

Furthermore, intelligent tutoring systems (ITS) are generally recognised for their ability to improve collaborative learning in adult education settings. Intelligent Tutoring Systems (ITS) are artificial intelligence-driven platforms that provide tailored education and feedback according to the specific requirements of individual learners, while also enabling collaborative learning activities (Graesser et al., 2018). These systems evaluate learners' interactions and provide instructors with advice on optimal grouping for collaborative work. By tracking progress and engagement, ITS may facilitate the formation of equitable learning teams, enabling learners to participate based on their skills and so promoting a collaborative educational atmosphere. Moreover, ITS can replicate real-world problem-solving situations that need collaboration among learners, hence enhancing the practicality and interactivity of adult education.

The influence of AI on mentoring in adult education is notably substantial. AI-driven systems may link learners with mentors globally, depending on certain skill sets, experience levels, or learning goals (De Laat, 2021). AI optimises mentoring by using algorithms to pair learners with mentors, therefore providing assistance customised to their individual and professional growth requirements. Moreover, AI solutions like virtual teaching assistants might enhance the mentoring experience by addressing mundane enquiries, therefore allowing human mentors to concentrate on more intricate and significant exchanges. This partnership between human and AI-driven mentors enhances the mentoring process, hence increasing the adult learning experience.

The significance of AI in promoting community development in adult education is paramount. Learning communities, vital for promoting peer interaction and collaborative learning, are being enhanced by AI technology. Artificial intelligence may monitor learners' engagement patterns, provide community-oriented learning activities, and motivate people to join in conversations or collaborative projects (Kukulska-Hulme et al., 2021). Through the analysis of learners' choices, AI may suggest relevant study groups or peer partnerships that correspond with the learners' interests or professional aspirations. This tailored method of community development fosters a feeling of belonging and collective purpose among learners, hence improving social interaction in educational settings.

Although AI technologies markedly improve collaborative learning and social interaction, limitations must also be acknowledged. The integration of AI in adult education must judiciously balance human engagement with machine-driven facilitation to prevent fostering a reliance on technology that undermines interpersonal ties. Moreover, issues pertaining to data privacy and the ethical use of AI in educational settings need meticulous attention to guarantee that AI systems are developed and implemented with the welfare and independence of learners as a priority (Holmes et al., 2019). Notwithstanding these obstacles, the potential of AI to enhance collaborative learning and social interaction in adult education is substantial.

Challenges and Barriers to the Adoption of AI in Adult Learning

The use of Artificial Intelligence (AI) into adult education offers several options to enhance learning experiences, improve accessibility, and facilitate personalised learning. Nonetheless, despite its promise, several problems and obstacles impede the extensive use of AI in adult

education. The impediments are mostly institutional, economical, and cultural, affecting both learners and educators. An examination of the literature indicates that these challenges are intricate, multifarious, and profoundly ingrained in existing educational frameworks and social constructs.

Institutional obstacles significantly hinder the implementation of AI in adult education. Institutions often encounter opposition to change, particularly in the adoption of new technology. A research by Teixeira and Mota (2021) indicates that educational institutions often exhibit reluctance in adopting breakthrough technologies such as AI, mostly owing to apprehensions over infrastructure, administrative preparedness, and the compatibility of AI with current pedagogical frameworks. This reluctance is intensified by a deficiency of AI knowledge among educators and administrators, resulting in ambiguity about the efficient use of AI systems in educational environments. Moreover, institutions often possess deeply ingrained systems and procedures that resist the seamless integration of new technology, rendering such attempts laborious and resource-demanding (Schiff, 2022). In the absence of a definitive implementation strategy, institutions may find it challenging to see the benefits AI might provide to adult education, resulting in hesitance to use these technologies.

Financial obstacles are a considerable problem. Implementing AI technology requires significant investment in infrastructure, software, and training. Numerous educational institutions, especially in economically disadvantaged areas, may be deficient in the financial resources required to implement and sustain AI systems. A research from the World Economic Forum (2020) emphasises that the expense of creating and sustaining AI-driven educational platforms is a significant challenge, especially for public institutions and adult education centres with constrained resources. Furthermore, even with financial resources at hand, the expenditure of educating educators to proficiently use AI in the classroom introduces an additional financial burden. This costly encumbrance may dissuade institutions from engaging in AI, despite its potential long-term advantages. Furthermore, as noted by Selwyn (2019), financial inequalities across institutions intensify gaps in access to AI-enhanced education, preventing many adult learners in underprivileged areas from reaping the benefits of these technological developments.

Cultural obstacles further hinder the use of AI in adult education. Artificial intelligence is often regarded with mistrust by both educators and students, who may consider it a threat to conventional educational roles and methodologies. Numerous adult learners, particularly those with little technical proficiency, may have discomfort with the reliance on AI for educational purposes. This unease stems from apprehensions around job displacement, the impersonal character of AI interactions, and worries about privacy and data security. Yang et al. (2020) indicate that adult learners often voice apprehensions over the dehumanising nature of AI-driven education, worrying it may lack the personal engagement and empathy characteristic of human instructors. Educators may also reject AI adoption due to concerns that technology may supplant their responsibilities or undermine their authority over the learning process (Maddox, 2021). Cultural resistance may impede the adoption and successful use of AI in adult education, as both learners and instructors grapple with reconciling conventional pedagogical paradigms with contemporary technology methodologies.

The view of AI by adult learners and educators significantly influences the future of AI in education. Adult learners, who often possess ingrained learning patterns and preferences, may

exhibit resistance to AI-driven educational systems. Research conducted by Tamim and Bernard (2020) indicates that older adult learners tend to exhibit scepticism towards AI, seeing technology as too intricate or inconsequential to their educational requirements. These learners may choose conventional, in-person training, which they see as more reliable and efficacious. Moreover, those with limited digital literacy may see AI as daunting, especially when confronted with intricate, AI-driven interfaces. The digital gap results in uneven access to AI-enhanced education, favouring digitally adept learners over their less skilled counterparts.

Educators often see AI with a mix of hope and apprehension. Some educators acknowledge AI's capacity to improve teaching via the automation of administrative duties and the provision of personalised learning pathways, while others voice apprehensions over AI's impact on pedagogy. Holmes et al. (2021) conducted a research revealing that instructors are concerned about the potential loss of their professional autonomy due to AI systems potentially controlling instructional material and pace. Concerns exist about the ethical ramifications of AI in education, especially in relation to data privacy and the possibility of algorithmic bias, which may reinforce disparities in educational performance. This ambivalence towards AI is exacerbated by a deficiency of professional development opportunities that would provide instructors with the requisite skills and knowledge to proficiently incorporate AI into their instruction.

Conclusion

The use of Artificial Intelligence (AI) into adult education presents revolutionary opportunities, altering how people interact with information and skill development. AI has the capacity to transform adult education via personalised learning experiences and the democratisation of education for marginalised populations. Utilising AI's capabilities, adult learners may access more flexible, adaptable, and personalised learning paths that address their own needs and preferences, hence enhancing engagement and autonomy in the learning process. Furthermore, AI's contribution to workforce development is becoming increasingly vital, assisting adult learners in reskilling and upskilling, especially as global economies transition towards automation and technology-oriented industries.

Nevertheless, the research also identifies other problems related to the use of AI in adult education. Ethical issues, including as data privacy, algorithmic bias, and spying, must be addressed to guarantee that AI systems are used in ways that prioritise the well-being, autonomy, and rights of learners. Moreover, institutional and financial obstacles impede the extensive implementation of AI, especially in resource-limited environments, prompting apprehensions over equal access to these sophisticated educational instruments. Moreover, whereas AI may augment humanisation in education, it also risks diminishing learning experiences to transactional, mechanised interactions if not meticulously structured.

Recommendations

To effectively use the capabilities of AI in adult education, various strategic measures are advised. Initially, educational institutions and politicians need to prioritise the development of human-centered AI systems that conform to ethical standards. This entails guaranteeing that AI technologies used in education uphold learners' privacy, alleviate prejudices, and foster comprehensive human development, rather than only enhancing learning results.

Secondly, initiatives must be undertaken to enhance access to AI-driven educational resources, especially for marginalised communities. Governments and educational stakeholders must invest in digital infrastructure and legislation that facilitate equitable access to AI technology, ensuring that marginalised learners are not excluded from this technological advancement.

Third, adult educators must get training to proficiently integrate AI technology into their instructional methodologies. This necessitates continuous professional development and cooperation among educators, technologists, and instructional designers to ensure that AI serves to augment, rather than replace, human education. Ultimately, further study is required to investigate new trends and developments in AI that might enhance the humanisation of adult learning. This may include examining AI's capacity to augment critical thinking, creativity, and social interaction, while evaluating innovative techniques that emphasise emotional intelligence and empathy in teaching. Through a deliberate and inclusive strategy for AI integration, adult education may be reformed to address the changing requirements of learners in a swiftly moving environment.

References

Adamson, C., Cornelius, S., & Kavanagh, D. (2022). AI and adult education: Opportunities and ethical challenges. *Journal of Educational Technology*, **13** (2): 88-101.

Ajibola, M. O., & Ogunyemi, A. O. (2020). The role of artificial intelligence in enhancing digital learning: Implications for adult education in Nigeria. *Journal of Educational Technology and Innovation*, **7** (2): 45-61.

Baker, R. S., & Yacef, K. (2019). The state of educational data mining in 2009: A review and future visions. *Journal of Educational Data Mining*, **1** (1): 3-17.

Baker, T., & Smith, L. (2019). Artificial intelligence in education: Promises and implications for teaching and learning. *Center for Curriculum Redesign*.

Baker, T., & Smith, L. (2019). Educ-AI-tion rebooted? Exploring the future of artificial intelligence in schools and colleges. *NESTA.*

Bates, T. (2019). *Teaching in a digital age: Guidelines for designing teaching and learning*. Tony Bates Associates Ltd.

Chen, Z., & Hong, Y. (2022). Chatbot-assisted learning and its implications for adult education. *Journal of AI in Education*, **34** (1): 112-129.

De Laat, M. (2021). AI-supported mentorship in professional development: Opportunities and challenges. *International Review of Education*, **67** (2): 235-252.

Eynon, R., & Malmberg, L. E. (2021). Understanding learning and the internet: Learners' experiences of using digital tools in higher education. *International Journal of Educational Research*, **105**: 101699.

Eze, C. U., Akinwumi, T. A., & Okeke, I. J. (2022). Overcoming barriers to effective adult education in Nigeria: The potential of artificial intelligence. *International Journal of Lifelong Learning and Development*, **12** (1): 89-105

Floridi, L., & Cowls, J. (2019). A unified framework of five principles for AI in society. *Harvard Data Science Review*, **1** (1).

Graesser, A. C., Forsyth, C., & Hu, X. (2018). Intelligent tutoring systems in adult learning: An overview of AI applications. *Educational Psychology Review*, **30** (1): 59-72.

Guan, Z., Wang, Y., & Zhang, Y. (2023). The role of AI chatbots in promoting collaborative learning in adult education. *Computers & Education*, **168** (3): 104205.

Holmes, W., Bialik, M., & Fadel, C. (2019). Artificial intelligence in education: Promises and implications for teaching and learning. *Center for Curriculum Redesign*.

Hung, J., & Zhang, K. (2020). AI-enhanced virtual classrooms: The next frontier in collaborative adult learning. *Journal of Educational Technology Systems*, **49** (2): 145-161.

Johnson, M. (2022). Self-directed learning and the challenges of AI. *Journal of Adult Education*, **45** (3): 123-139.

Knowles, M. S. (1980). *The modern practice of adult education: From pedagogy to andragogy*. Cambridge Books.

Luckin, R., Holmes, W., Griffiths, M., & Forcier, L. B. (2016). *Intelligence unleashed: An argument for AI in education*. Pearson.

Merriam, S. B., & Bierema, L. L. (2014). *Adult learning: Linking theory and practice*. Jossey-Bass.

Mezirow, J. (1997). Transformative learning: Theory to practice. *New Directions for Adult and Continuing Education*, **1997** (74): 5-12.

Odey, P. A. & Alabi, J. S. (2021). Teaching methodologies in Nigerian adult education: Challenges and prospects. *African Journal of Adult Education Studies*, **9** (3): 67-82.

Rogers, C. R. (1983). *Freedom to learn for the 80s*. Merrill.

Salami, R. O., & Adeyemi, B. T. (2021). The impact of digital technologies on vocational education: A case study of AI applications in Nigeria. *Journal of Educational Research and Development*, **5** (4): 112-129

Selwyn, N. (2019). Should robots replace teachers? *Education Week*, **38** (21): 48-49.

Selwyn, N. (2021). Digital inclusion: Can we talk about it too much? *Learning, Media and Technology*, **46** (4): 341-354.

Tuomi, I. (2020). The impact of artificial intelligence on learning, teaching, and education. *European Commission*.

Woolf, B. P. (2020). *Building intelligent interactive tutors: Student-centered strategies for revolutionizing e-learning*. Morgan Kaufmann.

Yang, Y., Qiu, M., & Liu, W. (2020). Transformative learning in virtual environments. *Educational Technology Research and Development*, **68** (5): 2365-2383.

Yin, X., Dong, Y., & Shi, J. (2021). Personalization in AI-enhanced education. *Educational Review*, **73** (2): 147-162.

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education. *International Journal of Educational Technology in Higher Education*, **16** (1): 1-27.