

REVOLUTIONIZING VOCATIONAL AND TECHNICAL EDUCATION IN NIGERIA: LEVERAGING AI, INNOVATION, AND CREATIVITY

**Abi, Onyuma Abigail¹, Uloko Grace², Angwa Jemaimah Ogeyi³
and Awuru, Mary Onyeje⁴**

^{1,3}Business Education Department,

^{1,2,3}College Of Education, Oju, Benue State

²Home Economics Department,

⁴Demonstration Secondary School, College Of Education Oju, Benue State

Abstract

Vocational and Technical Education (VTE) remains central to Nigeria's quest for industrialization, youth empowerment, and sustainable development. However, traditional Vocational and Technical Education (VTE) systems have not kept pace with the fast-changing demands of the digital economy. This paper looked into how Artificial Intelligence (AI), coupled with innovation and creativity can reposition Vocational and Technical Education (VTE) in Nigeria. It highlights AI applications in personalized learning, simulations, assessments, and curriculum design that can aligned with labour market needs. It went further to examine challenges such as infrastructural gaps, limited teacher digital literacy, policy implementation hurdles, and resistance to changes. This paper made recommendations, emphasizing policy reforms, industry collaboration, and teacher professional development as strategies to position Nigeria's Vocational and Technical Education (VTE) for global competitiveness.

Keywords: Vocational Education, Artificial Intelligence, Innovation, Creativity.

Introduction

Vocational and Technical Education (VTE) in Nigeria is a strategic driver of economic growth, as it equips learners with practical skills necessary for employment, entrepreneurship, and national productivity. In the context of Nigeria's youth-dominated population, high unemployment rates, and evolving digital economy, VTE must be repositioned to address both current and future workforce demands. Vocational and Technical Education (VTE) is pivotal for equipping individuals with practical skills and competencies necessary for national development, economic diversification, and poverty reduction. In Nigeria, VTE has been recognized as a strategic sector to foster economic growth and address the challenges of youth unemployment and skills mismatch (Korter in Onatere-Ubrurhe and Ubrurhe, (2025)

Uduafemhe, Ewim and Karfe (in Ukala 2025) noted that VTE as an aspect of education in Nigeria evolved from informal learning system to structured formal education that is geared towards eradicating unemployment, economic stability, and the rapid technological changes impacting the workforce. They also stated that VTE being driven by innovations in digital technologies, teaching technologies and collaborative learning strategies holds significant promise for improving the employability of the Nigerian workforce thereby enhancing its global competitiveness. Artificial Intelligence (AI) presents transformative opportunities for Nigeria's VTE sector. Through AI-powered learning platforms, digital simulations,

and intelligent assessment tools, vocational learners can acquire relevant skills for industries such as manufacturing, agriculture, ICT, renewable energy, and creative arts. When combined with innovation and creativity, AI has the potential to bridge Nigeria's skills gap, reduce unemployment, and foster sustainable economic development.

However, the existing VTE assessment systems in Nigeria often rely heavily on traditional, standardized testing methods, which inadequately measure students' creativity, problem-solving skills, and capacity for innovation (Edidiong et al., 2024). Globally, Artificial Intelligence (AI) has emerged as a transformative force in education, offering novel ways to improve teaching, learning, and assessment processes. AI technologies, including machine learning, natural language processing, and adaptive testing systems, are increasingly being used to personalize learning experiences and provide dynamic, real-time feedback tailored to individual students' needs (Hao, et al., 2024). Unlike traditional assessments that often emphasize memorization and standard responses, AI-enabled assessment frameworks can analyze complex patterns in students' performance, enabling educators to capture critical thinking, creativity, and problem-solving abilities more effectively. These intelligent systems can adapt the difficulty of questions based on learners' responses, identify misconceptions early, and suggest targeted interventions, thereby fostering deeper engagement and continuous improvement (Iqbal, in Randa, (2024). Moreover, AI-powered assessment tools are capable of evaluating open-ended and project-based tasks, which are vital for measuring creativity and innovation key competencies required for success in the 21st century workforce (Iqbal, in, Randa, 2024). Such technologies can process large volumes of data, including written text, multimedia submissions, and interactive simulations, to provide a more holistic evaluation of students' capabilities beyond conventional exams. The integration of AI into educational assessment also supports scalable and cost-effective evaluation solutions, addressing resource limitations common in many developing countries. Recent studies underscore the importance of leveraging AI to enhance educational outcomes in developing countries, where resource constraints and outdated assessment approaches hinder quality training (Hassan et al., 2022, Aderigbe, et al., 2023)

Numerous barriers continue to undermine the delivery of quality education to Nigeria's rapidly growing youth population. These challenges include outdated curricula, resource shortages, high rates of student dropout, insufficient funding, and overcrowded classrooms, particularly in rural areas (Odediji, Folawiyo, and Akinsuroju, 2023; Akinsuroju, Akinwande, and Anyanwu, 2018). Compounding these structural issues are persistent problems related to innovative leadership and policy development, which have significantly hindered meaningful educational reforms. Despite several reform efforts, inefficiencies in leadership and weaknesses in policy execution continue to prevent the sector from achieving global educational standards. AI possesses the capacity to fundamentally transform how Nigerian policymakers and educational leaders operate. Through predictive modelling, data analytics, and decision- optimization tools, AI can provide real-time insights into student performance, resource allocation, and policy impacts, thus promoting evidence-based decision-making (Luckin, 2017). Equipped with timely and data-driven information, educational leaders can engage in more dynamic, responsive, and

effective governance. Furthermore, AI can play a pivotal role in the formulation, implementation, and evaluation of educational policies. By employing machine learning and natural language processing technologies, policymakers can anticipate the long-term consequences of initiatives, analyze complex datasets, and craft policies that are more comprehensive, context-specific, and sustainable (UNESCO, 2021).

Innovation and Creativity

Innovation is the process of applying new ideas, methods, or technologies to solve problems or create value, while creativity refers to the ability to generate novel and useful ideas. In vocational and technical education (VTE), innovation and creativity enhance problem-solving, product development, and entrepreneurship. Creativity and innovation are critical for Nigerian learners to adapt to changing industries. Initiatives such as the Industrial Training Fund (ITF) and National Board for Technical Education (NBTE) have introduced entrepreneurial and ICT components in vocational curricula. Still, integration of AI and creative problem-solving remains a mirage.

Artificial Intelligence in Education:

Artificial Intelligence (AI) in education refers to the use of algorithms and intelligent systems to support and enhance teaching, learning, and assessment processes. AI applications include personalized learning environments, automated grading systems, and adaptive testing platforms that adjust in real-time based on student performance. The integration of AI can facilitate continuous formative assessment, provide instant feedback, and analyze large datasets to identify learning patterns and gaps (Holmes et al., 2023). AI technologies also support the evaluation of complex skills such as creativity and critical thinking through tools that assess open-ended tasks and project work. (Mahamuni et al., 2024; Ilieva, 2025). This makes AI a powerful tool for transforming educational assessment from static, one-size-fits-all models to dynamic, learner-centred systems.

Role of AI in Enhancing Creativity and Innovation Assessment

AI has the potential to revolutionize the assessment of creativity and innovation by enabling the evaluation of complex cognitive processes that traditional tests cannot capture (Acar, 2023). AI-driven tools such as natural language processing and semantic analysis allow for the assessment of originality and problem-solving strategies in student work (Rafner et al., 2023; Xie et al., 2022). Additionally, AI systems can support project-based assessments by analyzing multimedia submissions, simulations, and collaborative activities, thus providing a more holistic view of learner creativity (Bajahzar, 2024). Empirical research indicates that AI-enhanced assessments encourage learners to engage in innovative thinking by providing adaptive challenges and personalized feedback (Tan et al., 2024). These capabilities align well with the goals of VTE to produce not only technically competent but also innovative graduates. Ukala (2025) VTE has been defined as all forms and aspects of education that are technical and vocational in nature, provided either in educational institutions or under their authority, by public authorities, the private sector or through other forms of organized education, formal or non-formal, aiming to ensure that all members of the community have access to lifelong learning (UNESCO, 2022).

The objectives of VTE according Federal Republic of Nigeria (FRN) (2014) are to:

- a. Provide trained manpower in applied science, technology and commerce particularly at sub-professional level;
- b. Provide the technical knowledge and vocational skills necessary for agricultural, industrial, commercial and economic development;
- c. Provide people who can apply scientific knowledge to the improvement and solution of environmental problems for the use and convenience of man;
- d. Give an introduction to professional studies in engineering and other technologies;
- e. Give training and impart the necessary skills leading to the production of craftsmen, technicians and other skilled personnel who will be enterprising and self-reliant; and
- f. Enable young men and women to have intelligent understanding of the increasing complexity of technology.

As the landscape of work is undergoing rapid transformation, primarily driven by digitalization and automation; Information technology are redefining essential skills for workers, emphasizing not only traditional competencies but also the increasing necessity for new, transversal skills. The relationship between Vocational and Technical Education (VTE) and Artificial Intelligence (AI) is increasingly significant as AI technologies reshape industries and labour markets in so many ways such as: enhancing skill development through adaptive learning, and intelligent tutoring systems (ITS); industry-relevant training by using AI-driven models to predict for workforce readiness; entrepreneurship and creativity; and team work and collaboration.

AI has significantly impacted diverse sectors including education. VTE institutions are at the forefront of the transformation brought by AI by adopting it to enhance the learning experience and better prepare students for the workforce. Hence, AI provides VTE with opportunities such as tailored educational content as AI can be used to create customized educational content to cater for individual learners' needs (Odia, et al., 2025). It can facilitate interactive and immersive learning experiences using synthetic humans, virtual replicas of machinery, tools, or even historical figures relevant to a particular trade, providing personalized feedback and learning pathways. (Odia, et al., (2025) identified providing students with real-time feedback, simulating complex business scenarios, and offering a level of interactivity that traditional educational methods cannot match. Ndom-Uchendu & Nwokike in ogunade, (2025) stated that personalized learning, improved engagement, enhanced assessment, increased access to education and improved teacher training are some of the impacts of AI in VTE.

Enyi (2023) posits that leveraging AI technologies has plethora of opportunities to enhance learning experiences, improve student outcomes, create immersive learning environments, and streamline administrative tasks. Du &Wang (2023) and Westera et al. in Hassan (2022) AI-driven educational games and simulations offer engaging and interactive ways for students to apply their knowledge and skills in authentic contexts. They further stated that by incorporating elements of gamification and adaptive learning, educators can create learning environments that are not only

fun and engaging but also highly effective in promoting mastery of complex concepts and skills. Enyi (2023) further stated that understanding how to leverage AI in business processes gives students a competitive edge in entrepreneurship, enabling them to innovate and lead in their ventures.

AI refers to systems capable of performing tasks traditionally requiring human intelligence, including machine learning, natural language processing, and intelligent tutoring (Luckin et al., in Ukala 2025). Innovation and creativity are both outcomes and processes that involve generating novel solutions, designing products, and developing adaptive problem-solving skills (Amabile, in Ukala 2025).

Machine Learning and Adaptive Testing Techniques

Machine learning, a subset of AI, enables systems to learn from data and improve performance without explicit programming (Kumar & Sharma, 2023). In educational assessment, machine learning algorithms can analyze student responses to predict performance trends and customize testing difficulty accordingly Nair et al., 2023. Adaptive testing utilizes this capability to deliver personalized assessments that match the learner's proficiency level, thus providing more accurate measures of competence (Rathi, et al., in Ogunode, et al., 2023, Minn, in Enyi 2023). Studies have demonstrated that adaptive testing enhances learner engagement, reduces test anxiety, and better identifies individual strengths and weaknesses (Ihichr et al., 2024). Implementing these techniques in Vocational and Technical Education (VTE) can significantly improve the assessment of creativity and innovation by accommodating diverse learner profiles. The application of AI in education aligns with constructivist learning theories, which emphasize active, hands-on, and experience-based learning. Experiential learning approaches, as described by Kolb (1984), are particularly relevant in vocational education, where learners acquire skills through practice, reflection, and iterative improvement. Furthermore, the human capital framework suggests that investments in education, technology, and entrepreneurial skills increase individual productivity and contribute to economic growth (Becker,in Ukala). Combining AI with innovation-focused pedagogy enables vocational business programs to produce graduates who are both technically competent and entrepreneurial.

AI Applications in Vocational and Technical Education

a. Personalized Learning and Curriculum Design

AI facilitates adaptive learning, allowing students to progress according to their skill level. Intelligent Tutoring Systems (ITS) can guide learners through technical and business tasks, providing instant feedback and tailored practice (Woolf, in Kumar et al).

Additionally, AI can analyze labor market data to identify in-demand skills, ensuring that curricula remain relevant to industry needs (OECD, 2021). This approach allows institutions to implement modular, competency-based curricula that respond dynamically to market trends.

b. Virtual Labs and Simulations

Practical skill acquisition is central to vocational education, yet physical resources are often limited in Nigerian institutions. AI-powered simulations can recreate real-world business scenarios such as inventory management, sales

forecasting, or accounting workflows (Baker et al in Hassan 2022). Learners can experiment in safe virtual environments, iterating processes without real-world financial risk. Such tools also foster creative problem-solving, as students navigate diverse, AI-generated scenarios.

c. Entrepreneurship Support

AI can enhance entrepreneurial learning by providing idea-generation assistance, market analytics, and prototyping tools. For instance, generative AI systems can help student's design product packaging or create business plans, while predictive analytics tools can assess market demand (Cavallo et al, in Hassan 2023). Furthermore, AI platforms can connect students with mentors, microfinance providers, and local markets, bridging gaps between education and enterprise development.

d. Assessment and Feedback

Automated assessment systems offer immediate, data-driven feedback, allowing educators to focus on higher-order skills like creativity, leadership, and decision-making (Holmes et al., in Ile et al., 2021) Routine technical assessments, such as bookkeeping exercises or spreadsheet tasks, can be efficiently graded by AI, supporting mastery-based learning. Analytics generated by AI also enable teachers to identify struggling students' early, fostering targeted intervention.

Opportunities and Benefits

Integrating AI in vocational and technical education offers multiple advantages for the Nigerian context:

1. Scalability: Digital AI tools can reach large numbers of learners, including those in underserved rural areas.
2. Customization: Adaptive learning ensures that individual skill gaps are addressed, enhancing competence acquisition.
3. Entrepreneurial Readiness: AI enables learners to experiment, prototype, and validate business ideas, aligning education with practical enterprise development.
4. Efficiency: Automated assessment and administrative support reduce the burden on educators, allowing more focus on mentorship and creative facilitation.
5. Data-Driven Decision Making: AI analytics support evidence-based curriculum updates, resource allocation, and institutional planning.

Challenges in Implementation

Despite the potential, AI adoption in Nigerian vocational education faces several constraints:

1. Infrastructure: Limited internet connectivity, unreliable electricity, and inadequate hardware hinder effective deployment (Akinyemi et al in Akpan 2023).
2. Human Capacity: Teachers require training in AI tools, data literacy, and innovative pedagogy to effectively leverage technology.
3. Content Relevance: AI systems trained on global datasets may produce solutions not tailored to local contexts, emphasizing the need for localized content.

4. Cost and Sustainability: Licensing fees, device acquisition, and maintenance expenses may pose challenges for public institutions.
5. Ethical Considerations: Data privacy, security, and responsible AI use require clear guidelines to protect students.

Recommendations

1. Government agencies such as NBTE should update curricula to incorporate AI literacy, digital skills, and creative problem-solving.
2. Public and Private Partnerships should collaborations with Nigerian tech companies (e.g., Andela, Flutterwave, Interswitch) can provide AI tools, mentorship, and industry-driven training programs.
3. Teachers and trainers should undergo professional development in AI applications, digital pedagogy, and creative instructional methods.
4. Selected institutions can serve as innovation hubs to pilot AI-based teaching and gradually scale up.
5. Vocational curricula should blend technical training with creative thinking, innovation and entrepreneurship mindset.

Conclusion

In conclusion, technology has revolutionized many areas, including education. Artificial Intelligence (AI) is one of the most significant discoveries of recent years, having transformed teaching and learning processes across numerous disciplines. Artificial Intelligence (AI) has been around for years now, but its application in education is relatively recent development. AI in education refers to the use of AI technologies to enhance teaching and learning. This can include anything from AI-powered tutoring systems to AI-driven tools that help educators simplify tasks. While AI is still in its early stages of development, it has the potential to revolutionize the way students learn and lecturers teach. AI, innovation, and creativity collectively offer a transformative pathway for vocational and technical education in Nigeria. By enabling personalized learning, fostering entrepreneurial skills, and providing practical, data-informed experiences, AI can enhance both the quality and relevance of vocational programs. To achieve this potentials requires addressing infrastructure limitations, training educators, localizing content, and ensuring ethical data practices. With strategic planning and deliberate implementation, AI can position vocational and technical education as a critical driver of skills development and economic growth in Nigeria.

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