Disruptive Technology: The Preparedness for Artificial Intelligence and Innovative Skills Development in Technology Education in Nigeria

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Abstract

Artificial Intelligence has emerged as a quintessential disruptive technology, fundamentally altering industry landscapes and, consequently, the demands placed on educational systems. In the context of technology education and particularly Technical and Vocational Education and Training, Artificial Intelligence acts as both a subject of study and a pedagogical tool. African countries and Nigeria in particular are tagged as a 3rd World countries. This has made them lag in the scheme of global trends. Therefore, this paper is a qualitative study involving document analysis in Artificial Intelligence in Technology Education. The search for peer-reviewed journal articles was conducted in the Google Scholar database, based on a review of past studies on the AI model. The search period was from 2024 to 2025. 6,690 publications were found in the database. Automatic refining lowered the number to 640. Further filtering reduced the publications to 43. The paper shows a great imbalance and gap between the publications from the African continent and the rest of the world in Artificial Intelligence in Technology Education. Findings shows that only 2% of the articles were published in other African countries with one from Nigeria. It highlights the use of Artificial Intelligence in bridging the gap between education and industry, while addressing challenges related to ethics, infrastructure, and pedagogical adaptation. It noted infrastructural deficits as a major challenge to Artificial Intelligence adoption in Nigeria, and make recommendations for updated of school curricula to include Artificial Intelligence literacy, data science, ethics, and investment in Artificial Intelligence infrastructure and simulation technologies.

Keywords

Disruptive, Artificial Intelligence, Innovation, Skills Development, Technology Education

Introduction

Disruptive technology refers to new inventions that change the way things are done or take the place of old methods, leading to the creation of new markets and ways to deliver value (Alqahtani

Submission: 28 June 2026; **Acceptance:** 23 July 2026; **Available online:** July 2026

et al., 2024; International Labour Organisation, 2020; Olojuolawe et al., 2019; Peters, 2017). Artificial intelligence includes machine learning, deep learning, and natural language processing. It is not just a small upgrade. It changes how we perform tasks and make decisions in a big way. Artificial intelligence (AI) can be considered the leading component of the industrial transformation, enabling intelligent machines to execute tasks autonomously, such as self-monitoring, interpretation, diagnosis, and analysis (Bulathwela et al., 2021; Dvcgztv, 2023; Ritu Arya & Ashish Verma, 2024; Suleimenov et al., 2020). AI-based methodologies (especially machine learning and deep learning support manufacturers and industries in predicting their maintenance needs and reducing downtime. (Ahmed, 2022). The fast adoption of AI in industries like manufacturing, healthcare, and finance has made it very important for workers to have skills related to AI. Technology education is going through a big change. The old way of teaching technical skills, which usually focuses on fixed lessons and hands-on training, is not keeping up with the job needs of today. Therefore, adding AI to technology education is important to ensure that graduates are ready for the future, prepared for jobs, up-skilled in technology, and able to create new ideas.

Methodology

General information on methodology

Peer-reviewed journal articles published between 2024 and 2025 were used for this study. The aim was to gain insight into the disruptive tendencies and impacts of Artificial Intelligence in Vocational and Technology Education with a focus on Nigeria and African participation. To ensure consistency in the search and collection of sources for the review, the Google Scholar citation index service online was used. The database allows researchers to compose explicit strings to identify potentially relevant publications across a large number of collections in different subject areas, as shown in the framework. The inclusion and exclusion criteria were carefully set to ensure that extraneous material was not included. Keywords on the subject were carefully composed into search strings, as shown in Table 1.

Table 1: AI in TVET Search String

Main search: Artificial Intelligence
Sub search 1: Artificial Model + Vocational and Technical Education
Sub search 2: Artificial Intelligence Model + Technical Education

Inclusion and Exclusion Criteria

To narrow down the search for relevant review papers, publications with the following were chosen from the search engine: (i) papers published between 2024 and 2025, (ii) papers on Artificial Intelligence, Vocational Education, (iii) documents that are either journal articles or conference papers, (iv) papers that discusses Artificial Intelligence in Technology/ Technical Education. The exclusion criteria are: (i). articles in press, (ii) book chapters, (iii) articles published before 2024 and after 2025 and (iv) publications not written in English. The number was reduced to 640 records by this automatic refinement.

Furthermore, the filtered literature was critically reviewed through manual selection that was based on relevance to the topic and the contents of the abstract. 43 publications were finally selected for

the full-scale study. During the study, a meta-analysis table was formulated to capture data on the principal author and year of publication, document type, methodology, region, country, and theme.

AI as a Catalyst for Innovation in Technology Education

AI fosters innovation by changing how students learn and apply knowledge, encouraging creativity rather than rote memorisation. The basic innovative applications of AI are:

Personalised and Adaptive Learning

AI-powered platforms can be deployed to analyse student data, including learning speed, preferences, and knowledge gaps, to create personalised learning paths. In technology education, this means that students can receive tailored resources and remedial support in real-time, allowing them to master complex technical concepts at their own pace. Adaptive assessments adjust task difficulty based on performance, offering a more accurate evaluation of competence.

Virtual Reality and Intelligent Simulations

AI, when combined with Virtual Reality (VR) and the Internet of Things (IoT), provides safe, cost-effective environments for skills acquisition (Dvcgztv, 2023; Olojuolawe & Adeoluwa, 2022; Ritu Arya & Ashish Verma, 2024). For example, AI-powered diagnostic software can simulate complex computer hardware faults or industrial machinery breakdowns. This allows students to experiment, make mistakes, and troubleshoot in a virtual space without damaging actual equipment or incurring high maintenance costs.

Fostering Creative Problem-Solving

By automating routine, repetitive tasks such as basic coding, data entry, or administrative work, AI liberates students to focus on higher-order thinking. Generative AI tools (e.g., AI co-pilots) can assist students in brainstorming, generating design alternatives, or documenting technical projects, thereby fostering a "maker" culture and encouraging innovative thinking.

AI for Skills Development in Technology Education

The shift toward an AI-driven economy requires a new set of skills, blending technical proficiency with cognitive adaptability. These can be accomplished by attaining proficiency in:

AI Literacy and Technical Competencies

Modern technical education must move beyond basic digital literacy to include AI literacy, machine learning, and data analytics (Abdulmunem, 2023; Ahmed, 2022; International Labour Organisation, 2020; Kanbul et al., 2022; Olojuolawe & Olalekan, 2025; Ummah, 2019). Students need to understand how AI systems are trained, how they make decisions, and how to operate AI-integrated machinery. Programs that include AI modules produce graduates capable of managing smart automation systems.

Data Analytics and Predictive Decision-Making

A crucial skill in the era of IR 4.0 is the ability to interpret data. AI-enhanced curricula teach students to use data-driven diagnostics for preventive maintenance in manufacturing and to

analyse market trends in business education. This predictive capability enables students to make informed, data-backed decisions.

Bridging the Skills Gap

The gap between educational outcomes and industry demands is a major challenge, particularly in developing economies. Integrating AI tools into TVET programs ensures that students are trained on modern, industry-standard equipment. This alignment increases employability and prepares students for roles in emerging fields such as AI maintenance, IoT system design, and smart farming.

Challenges and Considerations in AI Integration

Despite its benefits, the adoption of AI as a disruptive technology in education is accompanied by significant risks and hurdles.

Infrastructure and the Digital Divide

The AI implementation requires robust digital infrastructure, including high-speed internet and modern hardware (Ritu Arya & Ashish Verma, 2024). In many developing regions, particularly in Nigeria, inadequate infrastructure and limited funding act as major obstacles. A lack of access to these tools can widen the educational disparity between rural and urban, or rich and poor, institutions.

Educator Preparedness and Resistance

The successful integration of AI relies on educators who are competent in using these technologies. However, many instructors lack sufficient training and digital literacy, leading to resistance to changing traditional pedagogical methods. There is a crucial need for continuous professional development to enable staff to adopt AI in their teaching.

Ethical Concerns and Bias

AI models can perpetuate biases present in their training data, leading to fairness issues in grading or assessment. Furthermore, over-reliance on AI can lead to diminished critical thinking and "cognitive offloading," where students stop thinking critically for themselves. Data privacy and security, particularly concerning student data, are also major considerations.

AI tools for innovation and skills development in technology education.

Here are key AI tools categorised by their function in technology education:

Coding and Software Development Skills

I. **GitHub Copilot:** Acts as an AI pair programmer, suggesting code, completing functions, and detecting errors in real-time for students in software-heavy fields.
II. **AskCodi:** Ideal for computer science or engineering students, providing coding assistance, debugging, and explaining complex programming logic.
III. **Windsurf:** A free alternative providing AI code completion for popular programming languages within IDEs.

IV. **Google Colab & Kaggle Notebooks:** Offer cloud-based, AI-enabled environments for executing Python/R code, data analysis, and machine learning simulations, providing free access to compute resources (CPU/GPU).

STEM and Technical Conceptual Understanding

I. **Wolfram Alpha:** A computational knowledge engine that solves complex math, physics, chemistry, and engineering problems step-by-step.
II. **Brilliant:** Offers hands-on, interactive challenges for building deep analytical, critical thinking, and reasoning skills in computer science and physics.
III. **Socratic (by Google):** Helps students with STEM homework by allowing them to photograph a problem and receive step-by-step guidance.
IV. **Simulation Tools (e.g., SimScale):** Brings high-end FEA/CFD simulation into the browser, allowing students to practice engineering design without expensive labs.

Innovation, Prototyping, and Design

I. **Uizard:** An AI-powered design platform that turns text, hand-drawn sketches, or screenshots into interactive visual prototypes, accelerating the design phase.
II. **Fusion 360 (Autodesk):** Offers generative AI design features for engineering students, allowing them to create optimised 3D models.
III. **Canva Magic Studio:** Allows students to create professional-looking presentations, infographics, and project visuals quickly to showcase innovations.
IV. **Napkin.ai:** Converts text-based lecture notes into structured diagrams, visual maps, and flowcharts, improving the visualisation of technical concepts.

Adaptive Learning and Personalised Tutoring

I. **Khanmigo (Khan Academy):** An AI tutor that guides students step-by-step rather than just providing answers, reinforcing mastery-based learning.
II. **Tutor AI:** Provides personalised learning sessions, quizzes, and examples, acting as a 24/7 personal teacher.
III. **Duolingo Max:** Uses AI to personalise language learning, offering interactive conversations and clear explanations.

Content Creation and Research Efficiency

I. **NotebookLM (Google):** Allows students to upload lecture notes or PDFs to build a personalised AI that summarises, quizzes, and creates study guides only from that material.
II. **Perplexity AI:** An AI search engine that delivers answers with citations to sources, aiding in efficient research and fact-checking.
III. **Curipod:** Uses AI to create interactive lessons, generating slides, polls, and drawing activities designed to spark creativity.

Key Benefits of AI in Technical Education

I. **Increased Engagement:** Interactive and gamified environments (e.g., Classcraft) make learning more active.
II. **Faster Feedback:** AI tools allow for immediate grading and feedback on code and written work, such as Grade Scope.

III. **Enhanced Accessibility:** AI tools like Otter.ai provide transcripts and summaries of lectures, helping students with hearing impairments or those needing review.
IV. **Bridging Skill Gaps:** Adaptive systems analyse performance to recommend targeted resources for struggling learners.

Findings and results

The articles were obtained from 5 regions of the world. These are Asia, Europe, Africa, Middle East and America with a highest percentage yield from Asia. The continental region of Asia recorded 46% of the publications and closely followed by Europe with 26%. The details is shown in Figures 1 and 2.

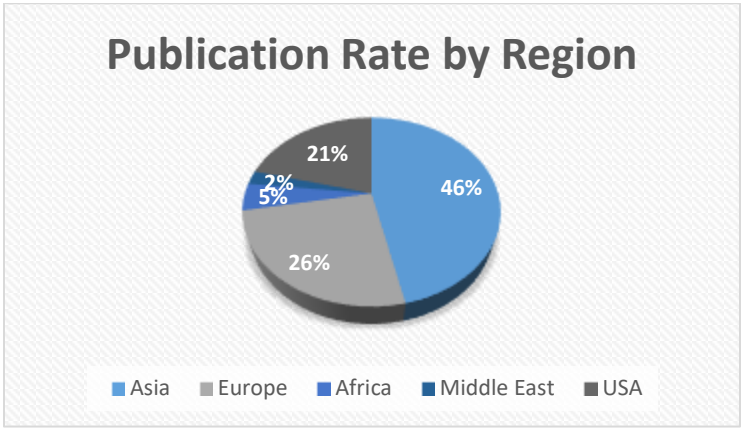

Figure 1: Continental Retrieval.

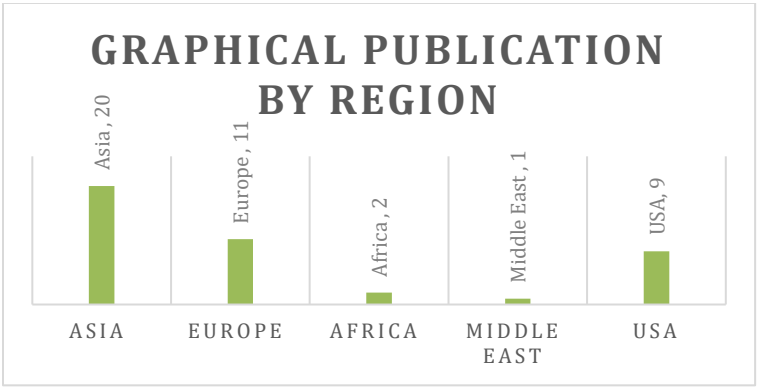

Figure 2: Continental Retrieval

The number of AI publications on Vocational and Industrial Technology Education by countries is graphically shown in Figure 3.

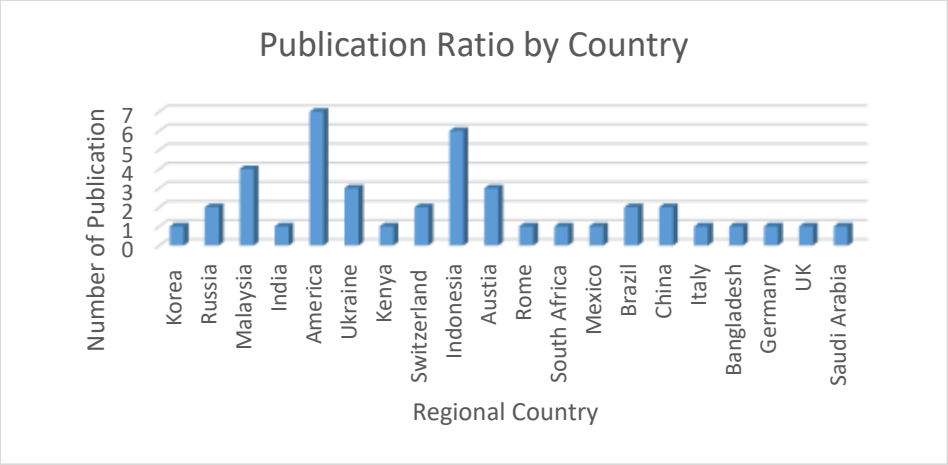

Figure 3: National Publication Rate.

Conclusion

Artificial intelligence has the potential to redefine technology education, creating a more innovative, personalised, and efficient learning experience. By navigating the attendant challenges with careful policy and planning, the integration of AI will produce a skilled workforce ready for the challenges of the 21st-century job market. The future of technology education lies in a balanced, human-centred approach where AI complements the teacher rather than replacing them. The integration of AI into technical education is a necessity, not an option, for national development in the era of the fourth industrial revolution. Therefore, to maximise the benefits of AI, governments in African countries and educational institutions should update their curricula to include AI literacy and data science, and invest in AI infrastructure and simulation technologies to be able to provide comprehensive training for educators to foster AI-enhanced pedagogy, establish robust ethical frameworks to ensure data privacy and mitigate algorithmic bias. Having unearthed the gap between AI adoption in African countries and the rest of the world, the need for African governments and educational institutions to shift attention to the methods of conducting research in Artificial Intelligence and the focus of AI research in Technology Education.

Acknowledgements

There are no grant or funding bodies to be acknowledged for preparing this paper.

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