



**ARTIFICIAL INTELLIGENCE IN POLYTECHNIC EDUCATION: STRATEGIES
FOR ENHANCING SKILLS ACQUISITION, EMPLOYABILITY, ETHICS AND
SUSTAINABILITY IN SOUTH EAST**

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Abstract

Nigerian polytechnics, in spite of reforms, face crisis situations unless Artificial Intelligence (AI) is actively enabled and incorporated into the Technical and Vocational Education and Training (TVET) programme to match up with the 21st century's emerging market demands. This is because traditional pedagogy slowly or refuses to keep pace with ongoing digital advancement and democratization. This has led to constant friction between graduate skill acquisition and the demand for labour. This study identifies and addresses critical gaps in available studies which have largely ignored South East, context-based AI status, including how resources constraints, ethical data considerations, and sustainable infrastructure lapses hamper the integration of this digital tool in TVET. Leveraging qualitative research method reviewed through Technological Determinism (TD) and Technological Determinism (CA), this research examines how digital experience and skills required for sustainable graduate employability can be impacted by the effective use of AI in the Nigerian polytechnic setting. The findings of this research recommend comprehensive overhauling of TVET curriculum to integrate AI-driven practical tools, with industrial partnerships to bridge digital infrastructure, electricity, and training deficits, and robust AI governance within the Nigerian polytechnic ecosystem in order to ensure lasting competitiveness and sustainable institutions.

Keywords: AI, Digital Transformation, TVET, Polytechnics

Introduction

Nigerian economy undergoes structural reforms that have minimal impacts on the entire population of polytechnic students

and graduates. One of the reasons for this is the over-reliance of traditional TVET methods when developed nations are already shifting towards rapid AI democratization, inclusion, and governance



in their education systems. Within global economies, TVET is a framework preparing youths for success in the global market workforce. This is because the contemporary times desire the digital competencies matching industrial professional experience, leaning toward knowledge-based economy (Hassan et al., 2021; Deckker et al., 2025). TVET that offers hands-on, productive knowledge diverse professional sectors (Deckker et al., 2025). Deckker et al. (2025) further opined that "TVET needs Information and Communication Technologies (ICT) integration in all aspects of pedagogy and delivery resources and education programs and curriculums and practice facilities to match technological developments (Hassan et. al., 2021)." This highlights the This stresses the urgent demand for innovative, particularly the adoption of Artificial Intelligence in the education system, as as TVET which is hosted within the Nigerian polytechnic subsector is programmed to serve as core driver for acquisition of technical and vocational skill sets, digital technological adaptation, industrialization and employment opportunities.

To ensure the realization of the Global Education 2030 Agenda, UNESCO (2023) stressed that, for TVET institutions, digital transformation ensures "learners have the skills and competencies necessary to contribute to the digital economy and society, resulting in more opportunities and driving progress towards the realization of the Sustainable Development Goals" (UNESCO, 2023). This emphasizes that learners are equipped with digital and green

skills which would make them remain relevant in the Fourth Industrial Revolution. Despite this global imperative, Nigerian polytechnics, about 152 in number which the National Board for Technical Education supervises and regulates (Njoku, 2021), suffer critical operational bottlenecks owing to over-dependence on traditional instructional methods and practices that disconnect from the current workplace realities and technological advancements, creating a widening gap between what polytechnic graduates learnt and the actual skills needed by industries in which they seek employment or business offers (The World Bank, 2023).

These polytechnics, according to the *NBTE Act* (as amended), are aimed at training technologists, technicians and mid-level management in courses "leading to the awards of certificates, ND, HND and Advanced Professional Diploma relevant to the needs, aspirations and the development of diverse economy and industries of Nigeria" (Njoku, 2021). Hence, the World Bank (2019) has already observed that limited digital infrastructure and minimal adoption of these emerging technologies are constraints to productivity and employment opportunities in Nigeria, thus: Nigeria will have to focus on enhancing foundations of a digital economy so as to benefit from the digital economy (World Bank's "Nigeria Digital Economy Diagnostic Report", 2019).

AI is, of course, an urgent institutional necessity, as it includes intelligence tutoring systems, virtual simulation-based training platforms, and generative



productivity tools possess the power to transform how technical and vocational competencies are imparted, examined and translated into sustainable opportunities which are vital to align graduates with modern, Industry 4.0 job markets. Notwithstanding the existence of *National Digital Economy Policy and Strategy* (2020) which stresses technological progress, implementation in Nigerian polytechnics is largely hindered by systemic, economic, and ethical data privacy constraints.

Statement of the Problem

Nigerian polytechnics, in spite of reforms, face crisis situations unless AI is actively enabled and incorporated into the Technical and Vocational Education and Training (TVET) programme to catch up with the 21st century's emerging market. This is because traditional pedagogy slowly or refuses to keep pace with ongoing digital advancement and democratization. This has led to constant friction between graduate skill acquisition and the demand for labour.

These polytechnics are established to produce mid-level graduates who can secure sustainable livelihoods or business offers, yet these graduates struggle to match dynamic skills demanded by contemporary industries (UNESCO, 2023). This is further compounded by poor infrastructure development, epileptic power supply, complete absence of dedicated AI laboratories, weak or absence of high-speed broadband, and lack of AI-trained manpower experience by these polytechnics (Leo, 2025). Studies revealed

a persistence youth unemployment increasing rate, particularly with skills not matching demands. While existing research focuses on one or two polytechnics within or outside South East, this study also evaluates the status of 8 public polytechnics' AI readiness in the South East of Nigeria using Technological Determinism and Technological Determinism to provide context-driven policy choices.

Further, little or no empirical focus has been on algorithmic bias and hallucinations as well as breaches of data privacy. Although the *Nigeria Data Protection Act* (2023) with guidelines from the National Information Agency through *Draft Code of Practice* (2022) spells out a legal framework, principles, rights, and obligations aimed at safeguarding personal data and information. In other words, the guideline is an expected obligation, "operational conditions, and compliance measures for Interactive Computer Service Platforms and Internet Intermediaries operating in Nigeria" (NITDA, 2022), introducing obligations on content takedown, reporting, local presence for large platforms, liaison officers, and annual compliance reporting to strengthen online trust and safety. Yet, enforceable at the polytechnic level remains weak. Without structured, contextual interventions addressing digital infrastructure, curriculum restructuring, and AI ethical governance, polytechnics in South East risk producing a generation of AI-technologically alienated graduates and manpower possible to worsen youth



unemployment, unproductivity, and economic stagnation. Abdullahi et al. (2026) in their paper specifically examined the urgent imperative for the re-engineering the Office Technology and Management (OTM) curriculum, which is a course of study in polytechnics. The scholars argued that "Hence, "continued reliance on legacy vocational skills leaves graduates systematically underprepared for a workplace that has already changed" (Abdullahi, 2023).

Significance of the Study

This research identifies several significant contributions within educational and industrial ecosystems. One, it provides an overview of extent or otherwise of digital transformation and AI-driven technology integration in Nigerian polytechnics. It also offers the management, educators and other stakeholders' context-focused lens embedded in Technological Determinism and Capability Approach for transitioning from traditional pedagogical models to participatory, AI-enhanced TVET programme. Further, it provides the policymakers with empirical understanding into resources and infrastructural challenges targeted at transitioning into AI-driven TVET policy and implementation focusing on the revised NBTE curriculum guidelines. This study also bridges the skills gaps for students, graduates, and industry partners by enhancing digital literacy, problem-solving abilities, sustainable employability in the competitive demand labour market, and minimizing corporate retaining costs which in turn will stimulate regional economic prosperity as outlined in

the agenda 2063 of the AU and the SDG Number 4.

Objectives of the Study

Basically, this study examines the AI strategies, tools, skills, and ethics that will enhance polytechnic education performance and products' employability. It also determines how AI-driven pedagogical models' impact on pragmatic skill acquisition and employability by identifying the major socioeconomic and ethical factors that hinder integration.

Research Methodology

A non-quantitative research method is adopted for this study. The researcher visited 8 public polytechnics in the South East. Alongside peer review conducted with 6 of the polytechnic administrators, and conducted thematic analysis of relevant online resource materials, including journals, conference papers, and publications from the UNESCO, UNHCR, the World Bank, NBTE, and NITDA whereas findings are evaluated through twin lenses of Technological Determinism and Capability Approach to examine the systemic, localized technological effects as well the freedoms and actualized potential of human agency.

Conceptual and Theoretical Underpinnings

This research interplays around Artificial Intelligence, Digital Technologies, TVET, employability and polytechnic strengthening. Artificial Intelligence (for short, AI) is a smart software invented to



perform tasks humans would ordinarily do. The earliest theoretical work on AI was by British mathematician Alan Turing in the 1940s and the first AI programmes developed in the early 1950s (Copeland, 2026). Hence, AI is the ability of an electronic machine to perform complex operations normally that are linked with human intelligence—a term applied to the development of proficient systems that can reason, discover meaning, generalize, or learn from past experience yet do not have the full capacity to match human flexibility (Copeland, 2026).

The foregoing is further corroborated by the fact that AI as robots are programmed to think, learn, and solve problems like humans would do (Akwo et al. (2026). Akwo et al. further offered extensive interpretations referring the automated machines as "systems that display intelligent behavior by analyzing their environment and taking action with some degree of autonomy to achieve specific goals (Boucher, 2020)", thus AI covers various subfields of "machine learning, natural language processing, robotics, and computer vision, all of which are designed to perform tasks that typically require human cognition (Anayochukwu, 2025)". AI operates through an algorithm that handles reasoning, learning, problem-solving, language understanding (Anyi Chukwu, 2025). For a fact, AI is an automated bot that generates contents which are normally crafted by humans. The bot generates responses by mimicking humans after a prompt by a human user. Contents generated are already available on

the storehouse of knowledge or databases elsewhere where the machine surf from, dubbed it and produce it for use. This is possible through the same algorithm—a set of rules or steps known as patterns. Simply put, AI learns from huge datasets, identifies structure, styles and context, and creates text based on what it learned. If the data requested is not available, the bot using a pattern that can mislead to forge the information. Contents from AI can be inauthentic, misleading, deceitful, and mechanical. And the information is often formulaic—easily detected by discerning experts. Notwithstanding, AI, thus, is transforming tertiary institutions of learning worldwide in the sense that it plays a wide range of roles in enhancing educational activities and processes (Akwo et al., 2026).

The UNHCR (2019) described TVET as encompassing education, skill acquisition, and training which relate to a set of occupations, production, services and livelihoods. TVET, in many nations, is an integral part of the national education sector which supports economic development by facilitating skilled manpower development linked to labour market needs. "TVET, as part of lifelong learning, can take place at secondary, post-secondary and tertiary levels and includes work-based learning (UNHCR (2019))." Artificial Intelligence in TVET, therefore, is the integration of automated language learning machines, including intelligent tutoring systems, simulation software and automated assessment resources into technical and vocational training courses and/or



management. The essence of AI-driven TVET programmes in Nigerian polytechnics is hands-on applications and industry-focused problem solving; hence the baseline is employability tailored through technical skill sets, adaptive capacity and digital competencies which allow polytechnic students and graduates to secure, maintain, and/or create job opportunities in the 21st-century workforce as stipulated by International Labour Organisation (2023).

Grounded on Technological Determinism and Capability Approach, this research posits that technologies in Nigerian polytechnics' ecosystem determine its sociocultural values and orientation as well as stress the introduction of AI strategies, tools, and ethical standards aimed at expanding the students or graduates' substantial digital capabilities and career freedoms. Technological Determinism, which American sociologist Thorstein Veblen (1857–1929) coined, is a reductionist theory. Ngwu et al. (2024), while agreeing that technology is the driving force upon societal change and progression, specifically traced Technological Determinism to Marshal McLuhan in 1964, noting also that Innis in 1950 first used 'technological determinism' before McLuhan elaborated on it to build it as a theory (Ngwu et al., 2024). It is important to further state that Technological determinism comprises variant concepts that are united to mean ideas and social development that are dependent upon technology, hence technology that has: "autonomy of

development (both in the sense of having an immanent evolutionary potential and its own logic of development, and in the sense of independence from socio-cultural control and self-sufficiency, up to understanding it as a *causa sui*); the development of technology is treated as progress; and the development of technology is emergent " (Mezentsev 2019).

Conversely, Capability Approach, as developed by 1998 Nobel Prize winner in Economics Amartya Sen (Comim et al., 2008; Kuhumba, 2017), "emerged as the leading alternative to standard economic frameworks for thinking about poverty, inequality and human development generally." (Clark, 2005) The conceptual foundations of Capability Approach rest on "Sen's critiques of traditional welfare economics, which typically conflate well-being with either opulence (income, commodity command) or utility (Clark, 2005).

Empirical reviews of literature show both the prospects and the systemic challenges of AI integration in polytechnics in South East. While UNESCO (2019) highlights that AI-supported adaptive education and simulation tools have enhanced technical skills and industrial readiness in TVET institutions when properly adopted, whereas the World Economic Forum (2025) further reveals that digital and AI literacy are among the fastest sought-after skills globally, making their integration urgently imperative, structural challenges remain strong. Several studies also point to the potentials of AI in education,



notwithstanding structural barriers. (Akinyele et al., 2018; Nwanhele et al., 2025; Okwara et al. 2024; Akwo et al. 2026) These scholars specifically identified infrastructure deficits, unstable electricity, and inadequate trained personnel as primary constraints to AI and digital technology inclusion in TVET institutions.

Yet, none of their studies examines AI technology relevance and effective use in polytechnics in South East. Other research further shows that many polytechnics in the South East do not have enough functional e-learning platforms and AI-supported resources such as Cognii, Squirrel AI, Assessment and Learning in Knowledge Spaces (ALEKS), IBM Watson Tutor, Duolingo, Coursera, Khanmigo, Century Tech, Smart Sparrow, Carnegie Learning MATHia, Syntea, Pixa VR, Transfr, Labster, ThingLink AI, Interplay Learning, ChatGPT Edu, Claude for Education, GitHub Copilot, GrammarlyGO, QuillBot, Zerogpt, Gradescope, Turnitin AI, FeedbackFruits, Packback, ELSA Speak, Speak, Replika for Education, Teachable AI, Canva Magic Studio, Synthesia, EdApp AI, etc. despite growing numerical strength of staff and student. These studies go further to show that most polytechnics lack structured ethical AI training which would have equipped students and staff with digital competencies and AI tools to enable them avoid abuse and misuse. This points to the urgent need for robust context-specific, polytechnic-focused policies and implementation grounded in UNESCO's Recommendation on Ethics of Artificial Intelligence adopted by 193 Member

States, stating that "AI must respect human rights and human dignity. It is grounded in key principles such as transparency, fairness, environmental sustainability, and human oversight of AI systems, which guide its ethical framework" (UNESCO, 2023).

Strategies for Enhancing Skills Acquisition, Employability, and Ethics, and Sustainability

While there is widespread, unmonitored, and informal use of AI tools such as Chatgpt, Gemini, Meta AI, GitHub, DeepSeek, Turnitin, Quillbot, Copilot, ZeroGPT, and other chatbots for curriculum delivery, learning, and research in many South East polytechnics, contents are often flagged for plagiarism, lack of human voice and creativity. Other abuses have been recorded, as many students and lecturers use Generative AI (GenAI) to create entire assignments, projects, research papers, and lesson notes without attribution that breaches academic integrity. No doubt, overuse of AI or outsourcing the human creative process to automated machines which undermine critical and analytical thinking. Also, the use of these platforms often occurs outside any known official institution-specific regulations and policy on AI. There is also clever use of AI detectors and paraphrasers to evade plagiarism checking. This erodes trust in the assessment processes, even when no direct evidence of misconduct is identified.

There are 8 recognized public polytechnics in the South East of Nigeria—Federal Polytechnic, Oko, Anambra State; Federal



Polytechnic, Nekede, Owerri; Akanu Ibiam Federal Polytechnic, Unwana; Ogbonnaya Onu State Polytechnic, Aba, Abia State; Anambra State Polytechnic, Mgbakwu; IMT Enugu; Enugu State Polytechnic, Iwollo, and Dr B. U. Nzeribe State Polytechnic, Awo Omamma (formerly Imo State Polytechnic, Omuma). These higher institutions of learning are statutorily mandated to train technicians, technologists and mid-level management yet continue to suffer persistent operational and academic challenges that undermine growth and effective performance (Njoku, 2021). It is worth noting to state that

"As polytechnics are mandated to produce industry-relevant, hands-on graduates, the adoption of AI technologies ranging from intelligent tutoring systems to predictive analytics offers promising opportunities for personalized learning, administrative efficiency, and workforce alignment. However, despite global advances in AI-driven education, Nigeria's polytechnics face considerable challenges, including inadequate digital infrastructure, limited AI literacy among educators, policy gaps, and funding constraints" (Anierobi et al., 2025).

Further, studies from most of the institutions show that curriculum delivery significantly remains theory-based and slow without reflection of industrial realities, while a diagnosis in 2019 by the World Bank revealed that unreliable power

supply and weak broadband penetration remain constraints to polytechnics in the South East. In a particular scholarly work, it is observed that availability of AI tools in Abia State Polytechnic (now Ogbonnaya Onu State Polytechnic) TVET programme is insufficient to effectively support students' learning and skill development. (Ukala et al, 2025).

2022 report by the Manufacturers Association of Nigeria (MAN) showed that employers in Aba and Nnewi consistently said that graduates lack the proficiency in automation and computer-assisted models. This is evidence of disconnect between skill demanded by employers and training acquired by employees. Public polytechnics in South East are at risk because most graduates are not trained for the modern-day market demands, given the global market transition towards Artificial Intelligence and knowledge-based economy.

Therefore, one of the most effective ways to improve acquisition of skill sets is functional restructuring of curriculum that actively integrates and implement AI practical tools into the NBTE/TVET programme. Training on AI-supported simulators such as Lander, Pixo VR, Interplay, Smart Sparrow, Century Tech, Carnegie Learning MATHia, offer an effective alternative where physical laboratory facilities are often non-functional and obsolete—some of these tools address the challenges of large class size and diverse learning needs. Most Artificial Intelligence tools have similarities while others "are unique in



specific task, such as writing, text to image/video, text to music". (Akwo et al. 2026)

Employability can be improved beyond curriculum redesigning. This is through industrial partnerships because government and polytechnic institutions do not have the fiscal capability and digital technology for their students and staff required for industry exposure. Investment in AI tools and training have already been canvassed by Okorieocha et al (2025). Although the African Development Bank and Huawei Technologies Co. Ltd have demonstrated actions in providing equipment, software licences and internship opportunities, public polytechnics in the South East can build partnerships with tech firms like Google and Meta to establish AI hubs tailored to industrial projects for students and graduates. Platforms like Google Classroom, Blackboard LMS, Moodle LMS, Microsoft Teams, Canvas LMS, Canvas Magic Studio, Duolingo, EdApp AI and others when incorporated into student training can increase the employability in global labour markets.

Therefore, for AI infrastructure to be effective in the long run, sustainability should be integrated from the conception stage to the implementation phase. One way to achieve this is the prioritization of renewable energy as an alternative option to electricity challenges. This can further be sustained when these polytechnics leverage existing funding avenues to provide solar-paneled AI infrastructure. Without this type of institutional commitment, any AI initiatives risk becoming and terminate with

donor-driven projects. Continuous monitoring and evaluation will also be useful to make sure that inclusion of AI translates into measurable outcomes instead of being an exercise in AI infrastructure procurement without functional results.

Findings and Conclusions

From the foregoing review of the status and readiness of public polytechnics in the South East, findings reveal a stark contrast between digital aspiration and regional realities. Findings show the erratic public power supply that restricts establishment, operations and/or implementation of AI infrastructure and resources. From the perspective of Technological Determinism, technology is a driving force for social and educational change. Therefore, until AI infrastructural technology is integrated, curriculum and pedagogy hardly improve. Again, the unmonitored use of Generative AI indicates that technology is though finding its way into the polytechnics from bottom-up, gradually transforming teaching and learning yet the impact is disruptive because institutions have not formally adopted in to the curriculum. Since the Technological Determinism suggests that technological advancement determines skills that are demanded in the workforce market, findings also reveal that polytechnics still produce graduates whose competencies mismatch with a AI technological economy.

Again, the polytechnic curriculum is overtly traditional, slow to adapt to change. Importantly, where adoption of AI is possible, it only remains individualistic,



unmonitored, informal and abused, thereby raising complex ethical concerns. Under Capability Approach, the aim of TVET is to enhance students and graduates' ability to secure employment. Yet non- or minimal AI skills acquired indicate capability failure. Capability Approach therefore requires that this technology enhance their freedom without threatening their ability for academic integrity and trust in the use of Artificial intelligence. Thus, integration of Artificial Intelligence into polytechnic education is imperative for revolutionizing TVET and securing sustainable employment. Public polytechnics in the whole of South East of Nigeria must enact clear-cut ethical standards encompassing data privacy, algorithmic fairness, academic integrity and inclusive education that align with the international best practices as laid down by UNESCO in 2021.

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