

Integrating Artificial Intelligence (Ai) In Technical And Vocational Education And Training In Public (TVET) Institutions In Abia State, Nigeria: Bridging Skills Gaps For Future Workforce

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Abstract

The rapid evolution of Artificial Intelligence (AI) is transforming industries worldwide, creating an urgent demand for a skilled workforce proficient in emerging technologies. In Abia State - Nigeria, Technical and Vocational Education and Training (TVET) is critical for equipping students with relevant technical skills; however, integrating AI into these programs remains limited. This study investigated the potential of integrating AI in TVET programs in public institutions in Abia state Nigeria, as a strategic approach to bridge skill gaps and prepare students for the demands of a future workforce. Three research questions guided the study. Descriptive survey design was adopted for the study. The population of the study consisted of 94 academic staff from School of Business and Management Technology, Abia State Polytechnic, Aba, and 240 managers from the 240 SMEs in Aba making a population of 334. Data for the study were collected through a structured questionnaire on a four-point Likert scale. Internal consistency of the research instrument was tested using Cronbach alpha and a reliability coefficient of 0.88 was obtained. Data collected were analyzed using mean and standard deviation. Findings from the study revealed among others that the availability of AI tools in Abia State - Nigeria TVET programs are not sufficient to effectively support students' learning and skill development. The study recommends that to effectively integrate AI into TVET, there should be availability of all resources needed for proper implementation of AI into TVET programs in public institutions in Abia state Nigeria.

Keywords: Artificial Intelligence, TVET, Skills Gap, Workforce Readiness, Education Technology.

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INTRODUCTION

In the dynamic world of Information Technology, there has been growing need to integrate Artificial Intelligence (AI) and other modern technologies in higher education and TVET in particular as TVET play a pivotal role in preparing its recipients for the workforce; and equipping them with the necessary skills, knowledge and attitudes to meet the demands of the digital era. AI has been described by Nwosu, Eko-Nweke and Zion-Ngoka (2024) and Nie (2020) as technical and scientific field devoted to the engineered system that generates outputs like forecast, content, and decisions for a given set of human-defined objectives. AI is a useful counterpart to people in everyday life as it has the capability to interpret and sort data at scale; solve complex problems and automate varied tasks simultaneously thereby filling operational gaps missed by humans. AI has been applied in various sectors, promoting transformation effects on education, finance, agriculture, transportation, healthcare, entertainment, etc. (Shuaibu, 2024)

Uduafemhe, Ewim and Karfe (2023) noted that TVET 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 went further to state that TVET 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.

TVET 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, 2009). The objectives of TVET according Federal Republic of Nigeria (FRN) (2014:14) P. 24 are to:

- Provide trained manpower in applied science, technology and commerce particularly at sub-professional level;
- Provide the technical knowledge and vocational skills necessary for agricultural, industrial, commercial and economic development;
- Provide people who can apply scientific knowledge to the improvement and solution of environmental problems for the use and convenience of man;
- Give an introduction to professional studies in engineering and other technologies;
- 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
- 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 Technical and Vocational Education and Training (TVET) and Artificial Intelligence (AI) is increasingly significant as AI technologies reshape industries and labor 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.

Maseko (2024) in his study revealed that there is a notable increase in the demand for specific technical skills, STEM skills, and training on ICT/digital and 3D technologies for TVET teachers and trainers.

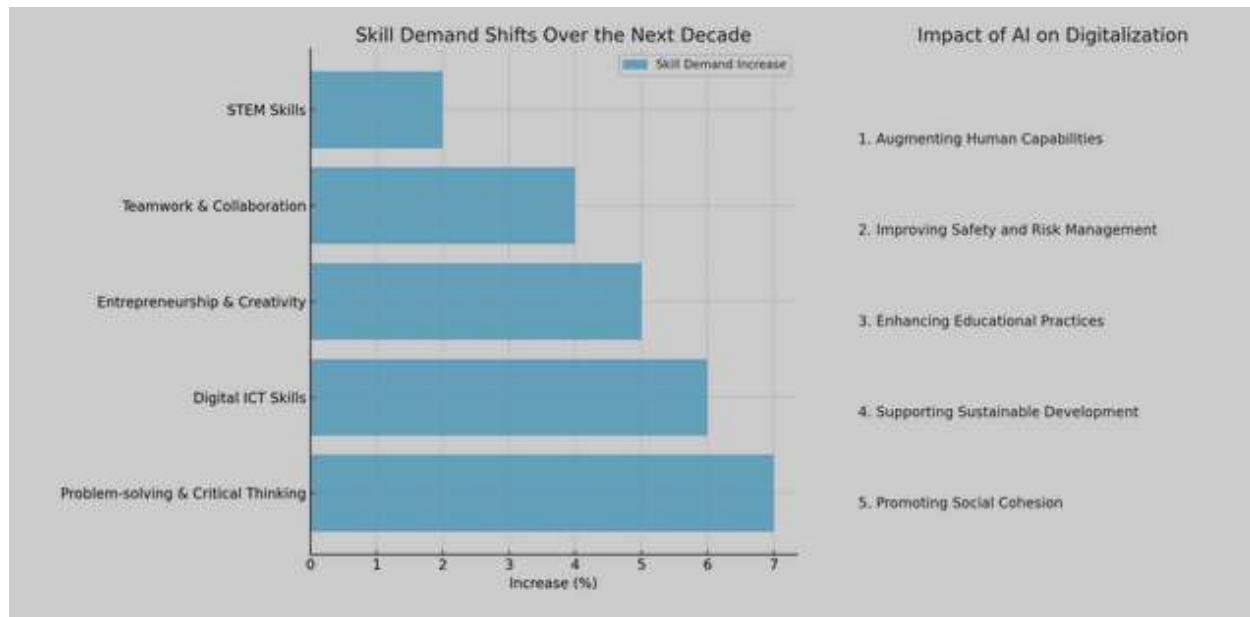


Figure 1: Skill demand shifts over the decade. (Maseko, 2024).

AI has significantly impacted diverse sectors including education. TVET 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 TVET with opportunities such as tailored educational content as AI can be used to create customized educational content to cater for individual learners' needs (Chiu et al., 2023). 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. McLaren (2024) identified providing students with real-time feedback, simulating complex business scenarios, and offering a level of interactivity that traditional educational methods cannot match.

To Ndom-Uchendu and Nwokike (2024) personalized learning, improved engagement, enhanced assessment, increased access to education and improved teacher training are some of the impacts of AI in TVET. Alam (2021) noted that leveraging AI technologies has plethora of opportunities to enhance learning experiences, improve student outcomes, create immersive learning environments, and streamline administrative tasks. To Du and Wang (2023) and Westera et al. (2020) 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. Olumuyiwa and Ayodele (2023) 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. They emphasized that AI

powered platforms can facilitates collaboration among students by matching them with peers who have complementary skills or interest.

Despite the diverse advantages and opportunities inherent in integrating AI in TVET in Abia State - Nigeria, Uduafemhe (2021) identified lack of adequate funding of TVET institutions, and negative societal perception of vocational education as the major challenges faced in the integration of AI in TVET in Nigeria. To Shuaibu (2024) some of the significant challenges facing AI integration in TVET in Africa are lack of infrastructure and resources needed to implement AI, and shortage of qualified trainers and AI experts and concerns about the ethical implications of AI. Adefolalu and Okebukola (2020) highlighted that the use of AI raises questions about data privacy, intellectual property and the authenticity of student work as it may be difficult to determine the extent to which a student's work is their own. Adeboye (2023) stressed that there are ethical concerns and the potential for overreliance on AI tools. Adeboye noted that while AI can enhance communication by offering suggestions, grammar corrections and content generation, there is a risk that students may become too dependent on these technologies. This reliance according to Uteh and Iheukwumere (2024) could undermine the development of critical thinking and creative problem solving skills, which are essential to entrepreneurship.

Uzo (2021) identified the need for teachers and students to develop new competences as a challenge in integrating AI into word processing activities in education. Teachers may not be conversant with AI tools or competent enough to integrate them into the curriculum as required. Again, students need to learn how to use these tools which most times are complex. Without good training the potential benefits of AI in word processing such as improving writing skills and automating repetitive tasks, may not be fully realized, limiting its impact on student empowerment, According to Oguniyi (2019), one of the primary issues in integrating AI into word processing activities in education is the lack of access to necessary technology and infrastructure. In many educational institutions, students may not have adequate access to the required software or reliable internet. This can leave some students at a disadvantage and hindering their ability to acquire essential word processing and entrepreneurial skills.

Statement of the Problem

Despite the growing importance of AI in various industries, Nigerian TVET institutions are yet to fully incorporate AI-related curricula and tools into their programs. This has led to a widening gap between the skills taught in schools and the competencies required by employers in the technology-driven economy. If this gap persists, Nigerian youth may face increasing difficulty in securing jobs in the AI-powered industries of the future. The challenge lies in integrating AI technologies and skill-building into TVET to ensure that students are not only prepared but also competitive on a global scale.

Research Questions

- How effectively are AI tools currently being integrated into TVET Public Institutions in Abia State programs to enhance students' technical and vocational skills?
- What are the key challenges in adopting AI technologies within Abia State Public Institutions TVET to enhance workforce readiness and skill competency?

- To what extent does the use of AI in Abia State Public Institutions TVET programs impact the workforce readiness and employability of graduates in alignment with industry needs?

METHODOLOGY

The descriptive survey research design was adopted for the study. The research design allowed the administration of questionnaire for data generation. The study was conducted in Aba, Abia state Nigeria using academic staff from the five departments in the School of Business and Management Technology (SBMT), Abia State Polytechnic, Aba; and 240 Small and Medium-sized Enterprises (SMEs) in Aba that are registered with the Abia State Board of Internal Revenue. The population of the study consisted of 94 academic staff from School of Business and Management Technology, Abia State Polytechnic, Aba, and 240 managers from the 240 SMEs in Aba making a population of 334. The researchers used the entire population in the study area, this was because the population of the study is manageable and sizable; hence it is a census population.

Data for the study was collected using an 18 item structured questionnaire. The instrument was divided into two sections, A and B. Section A contained items on the respondents' demographic data, while section B contained items addressing the research questions. The respondents were requested to rate the items on a 4-point rating scale of Strongly Disagree - SD, Disagree - D, Agree - A, Strongly Agree – SA. The instrument was validated by three experts and was further subjected to internal consistency testing using Cronbach Alpha which yielded a reliability coefficient of 0.86, 0.90 and 0.88 for clusters B1, B2 and B3 respectively with an overall coefficient value of 0.88. Out of the 334 copies of the questionnaire distributed to the respondents by the researchers with the help of ten research assistants, 311 copies (representing 93%) were duly completed, retrieved and used for data analysis. Data collected were analyzed using mean and standard deviation. The level of acceptance or rejection of each questionnaire items were determined based on the mean ratings of items interpreted relative to real limits of numbers: Strongly Agree 4 = 3.5-4.00; Agree 3 = 2.5-3.49; Disagree 2 = 1.5-2.49; Strongly Disagree 1 = 1.0-1.49.

PRESENTATION OF RESULTS

Research Question 1: How effectively are AI tools currently being integrated into Abia State Public Institutions TVET programs enhance students' technical and vocational skills?

Table 1: Mean ratings of respondents on the current effectiveness of AI tools integration into TVET programs public institutions in Abia state to enhance students' technical and vocational skills. N = 311.

s/n	Items	Mean	SD	Remark
1	AI tools in TVET programs have significantly improved the technical skills of students.	3.76	0.50	Strongly agree
2	The use of AI tools in TVET program provides students with practical, hands-on learning experiences.	3.65	0.79	Strongly agree
3	AI-driven tools are effectively integrated into the curriculum to address the specific skill needs of students.	2.16	0.58	Disagree

4	Students in TVET programs benefit from AI tools that offer personalized learning experiences tailored to their skill levels.	3.54	0.68	Strongly agree
5	AI tools in TVET programs adequately prepare students for industry-relevant technical competencies.	3.81	0.53	Strongly agree
6	The availability of AI tools in Nigerian TVET program is sufficient to effectively support students' learning and skill development.	1.34	0.62	Strongly disagree
Cluster Mean/SD		3.04	0.61	Agree

The result in table 1 revealed that items 1, 2, 4 and 5 were accepted with mean values of 3.76, 3.65, 3.54, and 3.81 respectively; while items 3 and 6 that had mean values of 2.16 and 1.34 respectively were rejected as their mean value were below the cut-off point value of 2.50. however, the cluster mean and standard deviation had a score of 3.04 and 0.61 respectively, thus, the respondents agree that the AI tools currently being integrated into Abia State public institutions TVET programs enhance students' technical and vocational skills.

Research Question 2: What are the key challenges in adopting AI technologies within TVET public institutions in Abia state to enhance workforce readiness and skill competency?

Table 2: Mean ratings of respondents on the key challenges in adopting AI technologies within TVET public institutions in Abia state to enhance workforce readiness. N = 311

s/n	Items	Mean	SD	Remark
7	Limited Infrastructure and Funding	3.76	0.50	Strongly agree
8	Shortage of Skilled AI Educators and Technicians	3.62	0.67	Strongly agree
9	High Cost of AI Tools and Software	3.73	0.57	Strongly agree
10	Resistance to Technological Change	3.72	0.50	Strongly agree
11	Alignment with Industry Requirements	3.55	0.60	Strongly agree
12	Data Privacy and Security Concerns	3.37	0.72	Agree
Cluster Mean/SD		3.62	0.59	Strongly Agree

Table 2 analyses indicated that all items were accepted as the key challenges in adopting AI technologies within Nigeria TVET institutions to enhance workforce readiness. The mean values of the 6 items ranged from 3.37-3.76 which are all greater than the cut-off point value of 2.50. The standard deviation values of the six items ranged from 0.50-0.72 which suggests that the responses of the respondents are close to each mean and the other, and they all strongly agree that the key challenges in adopting AI technologies within TVET public institutions in Abia state enhance workforce readiness and skill competency (mean = 3.62 with a SD = 0.59).

Research Question 3: To what extent does the use of AI in Abia State Public Institutions TVET programs impact the workforce readiness and employability of graduates in alignment with industry needs?

Table 3: Mean ratings of respondents on how the use of AI in TVET programs has impacted on workforce readiness and employability of graduates in alignment with industry needs. N=311.

s/n	Items	Mean	SD	Remark
13	AI-enhanced TVET programs provide students with the technical skills required to meet industry standards and expectations.	3.71	0.52	Strongly agree
14	The use of AI in TVET programs improves students' practical	3.60	0.62	Strongly agree

	and hands-on skills, making them more employable			
15	AI-driven learning in TVET allows graduates to adapt quickly to changing job requirements in the industry.	3.68	0.49	Strongly agree
16	Employers recognize AI-based training in TVET graduates as valuable for addressing skill gaps in the workforce.	3.76	0.45	Strongly agree
17	AI integration in TVET programs improves students' problem-solving and critical-thinking skills relevant to industry needs.	3.68	0.67	Strongly agree
18	Graduates from AI-enhanced TVET programs are more Competitive and ready for workforce demands compared to those from traditional TVET programs.	2.65	0.65	Agree
Cluster Mean/SD		3.52	0.47	Strongly Agree

The result in table 3 showed that the mean values of the 6 items ranged from 2.65-3.76 which are all greater than the cut-off point of 2.50. This indicates that the 6 identified items in the table are all accepted. The standard deviation values of the items ranged from 0.45-0.65 which suggests that the response of the respondents are close to each mean and the other.

DISCUSSION OF FINDINGS

Research question one sought the current effectiveness of the integration of AI tools into TVET programs in public institutions in Abia state, Nigeria to enhance students' technical and vocational skills. It was revealed among others that the availability of AI tools in TVET programs in public institutions in Abia state are not sufficient to effectively support students' learning and skill development; and that AI-driven tools are not effectively integrated into the curriculum to address the specific skill needs of students.

Research question two inquired into the key challenges in adopting AI technologies in TVET programs in public institutions in Abia state, Nigeria. The findings revealed that some of the key challenges are limited infrastructure, high cost of AI tools and software, resistance to technological change, shortage of skilled AI educators and technicians among others. This result is in line with Shuaibu (2024) who stated that some of the significant challenges facing AI integration in Africa are lack of infrastructure and resources needed to implement AI, and shortage of qualified trainers and AI experts.

Research question three investigated the extent to which the use of AI in TVET programs in Abia State Public Institutions has impacted the workforce readiness and employability of graduates in alignment with industry needs. The result revealed that the integration of AI technologies into TVET programs in Abia State-Nigeria will impact on workforce readiness in alignment with industry needs by providing TVET recipients with the technical skills required to meet industry standards and expectations; practical and hands-on skills; and problem-solving and critical-thinking skills relevant to industry needs. In a related study Maseko (2024) identified problem-solving and critical-thinking, and digital ICT skills as major impacts of integrating AI tools in TVET programs.

CONCLUSION

Based on the findings, the study concluded that integrating AI technologies in TVET programs in public institutions in Abia state, Nigeria will help in bridging skills gaps for the future workforce as TVET play a pivotal role in equipping its recipients with the necessary skills, knowledge, and attitudes to meet the demands of the digital era, as well as enabling them to be

self reliant which in turn will help in eradicating unemployment, and economic instability. Integrating AI technologies in TVET programs will also help in achieving the objectives of TVET according to Federal Republic of Nigeria (FRN, 2014).

Recommendations

- To effectively integrate AI into TVET in Abia State Public Institutions, there should be availability of all resources needed for proper implementation of AI into TVET programs in public institutions in Abia state Nigeria.
- Government, institutional organizations, private sectors should collaborate to develop training programs that equip trainers with the skills and competencies needed to develop and implement AI based programs in TVET institutions in Abia State Nigeria.
- To address the challenges faced in the integration of AI in TVET in public institutions in Abia state, Nigeria, a multifaceted approach that will involve government intervention, public awareness campaigns, and increased private sector investment should be adopted.
- To foster partnerships between vocational education institutions and the private sector, TVET institutions in Abia State should partner with the private sector to identify skills gaps and tailor TVET programs to meet the needs of the job market. This can help ensure that learners are equipped with the skills and competencies needed to succeed in the global economy.

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