

Integrating Artificial Intelligence into Technical and Vocational Education and Training in Some Selected Public (TVET) Institutions in Nasarawa State, Nigeria

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Abstract

In Nasarawa 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 most especially in our colleges of Education. Three research questions guided the study. Descriptive survey design was adopted for the study. The population of the study consisted of 25 academic staff each from School of Vocational and Technical Education, College of Education Akwanga (COEA), College of Agriculture Science and Technology Lafia (COAST) and Isah Mustapha Agwai the I Polytechnic Lafia, (IMAP) Nasarawa State and 231 managers from the 231 Small and Medium Enterprises (SMEs) in the study area making a total population of 306. The researcher gathered data through a well-developed questionnaire. Internal consistency of the research instrument was tested using Cronbach alpha and a reliability coefficient of 0.88 was obtained. The researcher used mean and standard deviation for data analysis result and interpretation. Findings from the study revealed among others that the availability of AI tools in the study area for TVET programs are not sufficient to effectively support students' learning and skill development. The study gave positive recommendations for effective integration of AI into TVET, and other related TVET programs in the state own institutions.

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

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. Technical and Vocational Training in Education play a significant role on the learners' workforce and equipping them with the essential skills, knowledge and attitudes to meet the demands of the present digital era. In the assertion of Nwosu, Eko-Nweke and Zion-Ngoka (2024) and Nie (2020) technically considers AI as one of the scientific field devoted to the engineered standard system that generates better products like forecast, content, and Page 1 of 3 decisions for a given set of human-defined objectives. 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. Technical Vocational Education and Training includes all forms and aspects of essential competences in education that are technical and vocational in nature, either in educational institutions or under authority, by 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 to Federal Republic of Nigeria (FRN) (2014) are to: 1. 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 that exist between Technical and Vocational Education and Training (TVET) cannot be overemphasized, as AI technologies continues to change industries and labor markets in diverse of 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. In the findings of Maseko (2024), there is a considerable and recognizable increase in the technical skills, STEM and training on digital technologies for TVET teachers and trainers. 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. Personalized learning, improved engagement, enhanced assessment, increased access to education as stated by Ndom-Uchendu and Nwokike (2024) 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. Their assertion was made 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. In the contribution of Olumuyiwa and Ayodele (2023), understanding how to leverage AI resources in business processes gives students a competitive edge in entrepreneurship, to enable them to innovate and lead in their ventures. As such, AI powered platforms can facilitate collaboration among students by matching them with peers who have complementary skills or interest as a sign of motivation within and among them. Despite the diverse advantages and opportunities inherent in integrating AI in TVET in Nasarawa State - Nigeria, Uduafemhe (2021) identified lack of adequate funding of TVET institutions, unqualified employed staff and their welfare 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 within and among humans, 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 by entrepreneurs.

The study also identified the need for teachers and students to develop new competencies as a challenge in integrating AI into word processing activities in Colleges of Education and Polytechnics, as stated by (Uzo, 2021). Teachers may not be conversant with AI tools or competent enough to integrate them into the curriculum as required due to factors beyond their reach. Again, students need to devote more time 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.

Despite the growing importance of AI in various industries, Nasarawa State 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 the institutions of learning and the competencies required by employers in the technology-driven economy. If this gap persists, the Nasarawa State youth in the said institutions may face increasing difficulty in securing jobs and also be fit into the society 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

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

3. To what extent does the use of AI in Nasarawa 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 Nasarawa state Nigeria using academic staff from the five departments in the School of Vocational and Technical Education and Training (SVTET), School of Vocational and Technical Education, (COEA), College of Agriculture Science and Technology Lafia (COAST) and Isah Mustapha Agwai the I Polytechnic Lafia, (IMAP) Nasarawa State and 231 Small and Medium sized Enterprises (SMEs) in Nasarawa State that are registered with the Nasarawa State Board of Internal Revenue. The population of the study consisted of 75 academic staff from School of Vocational and Technical Education, (COEA), (COAST) Lafia and (IMAP) Lafia Nasarawa State and 240 managers from the 231 SMEs in Nasarawa State making a population of 306. The researchers used the entire population in the study area, this is because the population of the study is manageable. 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 item 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 value of 0.88. Out of the 306 copies of the questionnaire distributed to the respondents by the researchers with the help of four research assistants, 301 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 Nasarawa State Public Tertiary 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 in public institutions in Nasarawa state to enhance students' technical and vocational skills. N = 301.

S/N	Items	Mean	SD	Remark
1	AI tools in TVET programs have significantly improved the technical skills of students.	3.74	0.50	Strongly agree
2	The use of AI tools in TVET program provides students with practical, hands-on learning experiences.	3.60	0.75	Strongly agree
3	AI-driven tools are effectively integrated into the curriculum to address the specific skill needs of students.	2.19	0.57	Disagree
4	Students in TVET programs benefit from AI tools that offer personalized learning experiences tailored to their skill levels.	3.50	0.66	Strongly agree
5	AI tools in TVET programs adequately prepare students for industry-relevant technical competencies.	3.78	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		3.03	0.63	Agree

The result in table 1 revealed that items 1, 2, 4 and 5 were accepted with mean values of 3.74, 3.60, 3.50, and 3.78 respectively; while items 3 and 6 that had mean values of 2.19 and 1.34 respectively were rejected as their mean value were below the cut-off point value of 2.50. however, the cluster means and standard deviation

had a score of 3.03 and 0.63 respectively, thus, the respondents agree that the AI tools currently being integrated into the 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 Nasarawa 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 Nasarawa state to enhance workforce readiness. N = 301

S/N	Items	Mean	SD	Remark
7	Limited Infrastructure	3.71	0.55	Strongly agree
8	Shortage of Skilled AI Educators	3.55	0.63	Strongly agree
9	High Cost of AI Tools	3.70	0.56	Strongly agree
10	Resistance to Technological Change	3.68	0.53	Strongly agree
11	Alignment with Industry Requirements	3.58	0.59	Strongly agree
12	Security Concerns	3.33	0.70	Agree
Cluster Mean/SD		3.59	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 3.33-3.71 which are all greater than the cut-off point value of 2.50. The standard deviation values of the six items ranged from 0.53-0.70 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 Nasarawa state enhance workforce readiness and skill competency (mean = 3.59 with a SD = 0.59).

Research Question 3: To what extent does the use of AI in Nasarawa 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=301.

S/N	Items	Mean	SD	Remark
13	AI-enhanced TVET programs provide students with the technical skills required to meet industry standards and expectations.	3.61	0.52	Strongly agree
14	The use of AI in TVET programs improves students' hands-on skills, making them more employable	3.57	0.62	Strongly agree
15	AI-driven learning in TVET allows graduates to adapt quickly to changing job requirements in the industry.	3.66	0.50	Strongly agree
16	Employers recognize AI-based training in TVET graduates as valuable for addressing skill gaps in the workforce.	3.78	0.46	Strongly agree
17	AI integration in TVET programs improves students' critical-thinking skills relevant to industry needs.	3.65	0.67	Strongly agree
18	Graduates from AI-enhanced TVET programs are more Competitive to workforce demands compared to those from traditional TVET programs.	2.66	0.65	Agree
Cluster Mean/SD		3.48	0.57	Strongly Agree

The result in table 3 showed that the mean values of the 6 items ranged from 2.66-3.78 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 0.46-0.67 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 Nasarawa state, Nigeria to enhance students' technical and vocational skills for development. It was revealed among other reasons that the availability of AI tools in TVET programs in public institutions in Nasarawa 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. This is also in line with the findings made by Mhlanga (2023), who points out that in Africa, a lack of technology infrastructure and a lack of skills impede the integration of AI in education. Research question two inquired into the key challenges in adopting AI technologies in TVET programs in public institutions in Nasarawa state, Nigeria. This is because some of the key challenges are limited infrastructure, high cost of AI tools and software, cultural 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 Nasarawa State Public Institutions has impacted the workforce readiness and employability of graduates in alignment with industry needs. This is because school is a function of an industry which equip learners with the necessary tools to be fit into their relevant industries. The result revealed that the integration of AI technologies into TVET programs in Nasarawa 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 Nasarawa state, Nigeria will help in bridging skills gaps for the future workforce as TVET play a pivotal role in equipping its learners 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

1. Policy makers and curriculum implementers should effectively integrate AI into TVET in Nasarawa State Public Institutions, for available and accessible resources needed for proper implementation of AI into TVET programs in public institutions.
2. There should be positive collaboration between the staff of TVET institutions in Nasarawa State, Institution organizations, private sectors and the state government to develop training Programs and manuals that equip trainers with needed skills in AI based programs.
3. There is a need for the Ministry of Education in Nasarawa State to organize conferences,

seminars and workshops for lecturers as one of the multifaceted approaches that involves government intervention or public awareness on the effectiveness of AI adoption in education.

4. The staff and facilitators in TVET institutions in Nasarawa State should partner with the private sector to identify relevant skills gap and tailor TVET programs to foster partnerships and encouragement between vocational education institutions and the private sector, with the needed competencies to succeed in the global economy.

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