

IMPLICATIONS OF INTEGRATING ARTIFICIAL INTELLIGENCE IN TECHNOLOGY AND VOCATIONAL EDUCATION PROGRAMME IN NIGERIA

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Abstract:

The integration of Artificial Intelligence (AI) into the educational systems is revolutionizing the delivery of skills and knowledge, particularly in specialized disciplines such as Technology and Vocational Education (TVE). This paper explores the transformative potential of integrating AI into TVE, an educational programme that combines practical skills and theoretical knowledge in areas like Automobile Technology, Building Technology, Electrical/Electronic Technology, Metalwork Technology, Woodwork Technology, among others. As education continues to embrace digital transformation, AI tools such as adaptive learning platforms, automated assessment tools, intelligent tutoring systems, and visual simulations offer dynamic personalized, and interactive learning experiences and improve academic outcomes. Therefore, the main objective of this study is to elucidate the benefit of integrating Artificial Intelligence into Technology and Vocational Education in Nigeria. Thus, the paper explores, highlights, and discusses the scope/concept of TVE and AI, the role of AI in TVE, challenges and concerns of integrating AI into TVE and the need for a cautious and critical approach, setting limits to the integration of AI into TVE and also calls for proper investment in AI and TVE, not only for equipping the learners and trainees with relevance skills and knowledge for employability, but also for poverty reduction, job creation, economic growth and sustainable development.

Keywords: Artificial Intelligence, Implication, Integration, Technology and Vocational Education.

INTRODUCTION

Background to the Study

The advancement in science and technology has raised awareness among the public about the significance of technology mastery. One of the technology that has experience rapid development and has the potential to transform the way Technology and Vocational Education (TVE) programmes are conducted is the Artificial Intelligence (AI). TVE is a training that assist the trainees to develop a skilled workforce and also promote their employability. As such, for TVE to be more effective, AI technology must be integrated into the TVE programmes for an anticipated result. The introduction of AI technology into TVE is becoming an important consideration as the AI technology tends to equip the learners with the competences needed to search, evaluate and use information and knowledge, as well as actively creating and communicating in variety of formats and platforms. The utilization of the Artificial Intelligence technology has grown rapidly globally. Its impact in various aspects of human life cannot be underestimated (Luger, 2022). Artificial Intelligence (AI) plays significant role in the educational sector and especially in TVE, it represents an initial step in the development of learning technologies (Kusumadewi, 2023). Kusumadewi further pointed out that Artificial Intelligence has the potential to revolutionize the way we teach and learn, making life more efficient, effective and accessible because it is being used in wide range of ways in education. Nura, (2024) is of the opinion that Artificial Intelligence holds immense potential to enhance the quality of TVE programme in Nigeria through personalized learning, skill gap identification and support for sustainable innovation.

Technology and Vocational Education (TVE) is considered by many countries in the world as essential to their development, as it is linked to training on skill acquisition, job creation and poverty alleviation. TVE is the foundation of any nation wealth and sustainable development, and the type of education that is meant to provide skilled and technical manpower necessary to restore, revitalize, energize and sustain the nation's economy and substantially reduced unemployment (Kumbasi, 2021). This implies that Technology and Vocational Education plays a vital role in

preparing skilled and trained manpower for technological advancement and sustainable development of any nation. Therefore, in an increasingly complex and rapidly changing world, TVE must continuously adapt to the technological advancement. We cannot deny that rapid pace of AI technology has brought significant changes to the education sector including TVE (Anitah, 2022).

The integration of AI into TVE has the potential to transform the learning experience for TVE students, support teachers and provide accessible education for all. The power of AI in skill acquisition lies in the ability to create more engaging, effective and equitable learning environments. By leveraging on the potential of AI, Nigeria can significantly improve the quality and relevance of TVE by equipping its youths with requisite skills needed to thrive in the 21st century job market. This can foster a generation of skilled experts who are well prepared for the challenges of the future. The AI revolution has the potential benefits for Nigeria by keying into AI to transform Technology and Vocational Education and create a skilled workforce capable of driving economic growth.

Technology and Vocational Education: An Overview

Technology and Vocational Education (TVE) is a form of education that provides individuals with practical skills, theoretical knowledge and attitudes needed for specific occupations and the world of work. It includes the study technologies and related sciences to prepare the recipients for employment, career advancement and self-reliance in various sectors like engineering, agriculture, trades, and other businesses (Gwazayet, 2021). According to Benaiah, (2023) Technology and Vocational Education (TVE) is a form of education that prepare students for specific careers by teaching them practical skills, knowledge and attitudes for a particular trade or occupation. It combines the general education with hand-on training in technology, applied sciences and other related fields to equip individuals for employment and economic self-reliance in areas like cosmetology, auto-mechanics, building construction, culinary arts, computer repairs carpentry among others. Technology and Vocational Education is a comprehensive term referring to those aspects of the educational process involving, in addition to general education, the study of practical skills, attitudes, understanding and knowledge relating to occupations in various sectors of economic and social life (UNESCO, 2020).

Concept of Artificial Intelligence

The creation of computer systems and algorithms that can carry out tasks that typically require human intelligence is known as artificial intelligence (AI). Artificial Intelligence refers to the simulation of human intelligence processes by machines, especially computer systems. Norvig (2020) view Artificial Intelligence as the simulation of human intelligence processes by machines especially computer systems. These processes include reasoning, learning, problem-solving and understanding language. It is a wide-ranging branch of computer science that refers to the production or mimicking of human-level intelligence, skills, self-awareness and thought in computer programs (Ben-Li, 2023). AI can take various forms in education such as personalized learning platforms, intelligence tutoring systems and learning analytics, all of which can be integrated into instructional practices in TVE.

THE ROLE OF AI IN TECHNOLOGY AND VOCATIONAL EDUCATION

The integration of AI in TVE is a promising avenue for enhancing skills development, improving learning outcomes, and bridging the gap between education and the job market. Ben-Li. (2023) maintained that AI has the potential to revolutionize TVE by providing innovative solutions and addressing several key issues such as:

Personalized Learning: One of the key benefit of AI is its ability to personalize learning experiences. AI can tailor teaching to the needs of individual learners based on their individual strength and weakness. The AI powered tutor application can also provide real-time feedback, answer questions and tailored instructions/explanation.

Skill Development: Another key benefit of AI is its ability to stimulate and create conducive environment for the learners to acquire and practice skills in a safe and controlled setting.

Virtual Simulation: AI powered virtual simulation application can provide hand-on experience in a safe and controlled environment.

Skill Gap Identification: AI can analyze job market trends and also identify skill gap and help institutions adjust curricula accordingly.

Enhanced Job Placement: AI can equally analyze job market trends, identify in-demand skills, and match skill with job vacancies, thereby improving employment opportunities. AI can recognize skill gap and provide recommendations for curriculum adjustment helping institutions to align their curriculum with industry needs and demand.

Automated Assessment: This AI application can automate the process of assessing student's skills, thereby, providing consistent and objective feedback and freeing up teachers time for more interactive teaching.

Evaluation and Assessment: The significant of evaluation and assessment is to refract learning outcomes. AI evaluation and assessment tool has been developed to measure students learning and progress in AI related skills. It is also used to evaluate the overall impact of AI on student's learning outcomes, the effectiveness of teachers and the institutional performance.

Accessibility and Inclusiveness: AI has the capability to make TVE more inclusive and accessible. It can translate educational materials into multiple languages, thereby, making TVE accessible to a wider range of students. It can also assist students with disabilities by ensuring equal access to TVE programmes.

Partnership and Collaboration: This is the ability of government to collaborate with industries and other stake-holders in order to identify AI-related skills and knowledge requirements. Such partnership and collaboration should be extended to academic institutions especially TVE training institutions to develop AI-focused curricula and research projects. It could also go further to seek funding support for infrastructural development.

Teacher Training: The need to upskill TVE teacher's knowledge and abilities on the application of AI in TVE is paramount. AI can provide TVE teachers with training on AI tools, methodologies, and pedagogical approaches to effectively incorporate AI into their teaching. AI can also provide personalized professional development resources for TVE teachers, assisting them stay up-to-date with the latest teaching methods. Regular development with additional support for TVE teachers will equip them with skills, knowledge, abilities and professional resources to carry their functions effectively.

Curriculum Development: When developing TVE curricula, focus should be on practical application of AI in various industries in order to prepare the learners for real-world employment. Therefore, aligning AI-related content with existing TVE curricula to ensure relevance and the ability to complement each other is paramount.

Administration and Task Automation: AI technology is revolutionizing the way schools and other institutions manage administrative tasks and how teachers automate their daily workloads. By adopting AI, the technology can streamline administrative work reduce the amount of time that teachers/tutors spend on administrative tasks.

INTEGRATION OF AI INTO TVE

The integration of AI in TVE programme is very significant to the Nigeria educational system. In order to ensure sustainable development in Nigeria, it is crucial to develop a skill and knowledgeable workforce that is equipped with the needed and essential technology. Nigeria can produce a competent and strong workforce by integrating AI into TVE. AI-powered adaptive learning system can help to address the challenges of inadequate TVE tutors. Intelligence tutoring system can offer real-time feedback and assessment, while AI-driven chat-bots can provide personalized learning experiences for students. The demand for skilled workforce with digital technological knowledge is rapidly increasing in the global economy and that is one significant reason for integrating AI in TVE programme especially in Nigeria (Zakka, 2025).

Furthermore, the requisition for new technological skill and knowledge, and the changes in the labour market demands will require innovations that can adapt to changing industry demands and the integration of new skills in TVE. Therefore, the perception need to change in transforming the TVE landscape in Nigeria, particularly in providing adequate training in technological skills for some certain occupations. The general direction that can revolutionize or change the future of TVE in Nigeria according to Zakka, (2025) will be driven by:

Increased emphasis on Technology and Vocational Education and practical skills, with conventional education giving way to greater emphasis on practical abilities.

Increased embracing of digital technology in TVE which can prepare students for smooth transition to industry.

Increased collaboration between TVE and industry by providing internship and assisting in curriculum development, ensuring graduates acquire the skill required by employers.

Increased focus on entrepreneurial skills to build an entrepreneurial culture.

There is no doubt on the importance of investment in technology infrastructure and the development of supportive of educational policies in the Nigerian TVE. The integration of AI in Nigerian TVE is a promising avenue in enhancing skill development, improving learning outcomes, bridging the gap between education and the job market and enhancing sustainable development.

PROSPECTS OF INTEGRATING AI IN TVE

Artificial Intelligence is a modern transformative technology that has the potentials to revolutionized and drive better efficiency and innovation in all facets of life. Integrating Artificial Intelligence into Technology and Vocational Education presents multiple opportunities and challenges that shape the academic landscape and the way knowledge is generated and assessed. Some of the opportunities as identified by Ben-Li (2023) were describe below:

Personalized Learning Experiences: One of the significant benefit of integrating AI in TVE is its ability to personalize learning experiences. Personalize Learning is a form of education that is based on personalization, tailoring learning to the strength, needs and interest of each student (Patrick et al, 2023). AI can help personalize the learning experience for each student. By monitoring students' progress in real-time, AI can adjust the content and difficulty level of the material according to students needs and abilities. This will help to ensure that every student receives a learning experience tailored to their needs. By utilizing AI technology for personalize learning, students can acquire a more effective and efficient learning experience according to their needs and abilities

Augmenting Career Readiness: AI technology has the potential or the ability to prepare students for future career. By introducing AI technology in TVE, students can gain firsthand experience with cutting-edge skills that could be applied to various industries. In TVE, career readiness can be enhanced through exposure to AI-related fields like machine learning, data analysis and AI programming.

Enhance Students Engagement: AI-powered interactive tools can make learning more engaging for students by providing a more dynamic and personalized experience. AI-driven games related practical skills acquisition can spark students' interest and motivation.

Catering for Diverse Learning Needs: AI technology can accommodate a wide range of learning styles and needs, providing tailored learning experiences for students with diverse cultures, traditions and backgrounds. This pliability is crucial and beneficial especially in TVE programmes, where students may come from different backgrounds with varied educational experiences.

Encourage Life-long Learning: AI technology can enhance life-long learning by providing accessible resources that students hold back to after the usual general education. For instance, AI tools that track learning process can recommend relevant contents for students that wish to further their skills in areas like automobile, building construction, metalwork, electrical/electronic, woodwork, among others.

Improve Efficiency in Teaching: AI technology has the ability to automate repetitive tasks such as grading assignments/exams, tracking students' progress, and classroom management. This will allow teachers to spend more time focusing on direct instruction and personalized support, rather than administrating tasks.

Lesson Plan Creation: Artificial Intelligence is transforming course and lesson plan creation in Technology and Vocational Education programme, making it faster and more efficient than ever before. AI powered tools can help teachers/tutors create high-quality, personalized courses and lesson plans that align with the curriculum and students' needs and interest.

Test-Taking Skills: AI technology Test-Taking tools are transforming the way teachers prepare students for examinations. By using the natural language processing technology, these tools can analyze student data and provide targeted practice exercises to help students improve in their Exams and Test-Taking skills.

Improved Virtual Learning: AI technologies that are currently and widely implemented in various educational technology platforms, especially those based online serve as Virtual Learning Mentors. This AI tool can provide feedback on students learning activities and exercises, and then

recommend materials that need to be reviewed, just like teacher or tutor. The technology can also identify the reason(s) behind students misunderstanding and proffer solutions.

Automated Assessment System: Artificial Intelligence can assist in automatically and quickly evaluating students' performance. By utilizing natural language processing and machine learning technologies, AI can read and assess students' assignments within a very short time. This enable teachers and educators to provide instant feedback and help students improve their skills. The system can generate scores automatically, reducing the time and costs required for manual assessment.

Prediction of Students Progress: AI can gather data from various sources to assist in predicting students' future progress. By utilizing historical data, AI can estimate whether students will succeed or require additional support in achieving their goals. This will enable teachers/instructors to effectively assist students in reaching their full potential. An example of using AI in predicting students' progress is by employing machine learning method to analyze patterns in students past progress data and using those patterns to forecast their future progress. Thus, in developing AI system for predicting students' progress, it is crucial to consider privacy and data security factors concerning the student involved in the system.

Voice Assistant: The AI-voice assistant is a technology that enable users to command devices to perform various services and answer any user quarries. Voice Assistant is an Artificial Intelligence program designed to assist humans in using smartphones or computers, as they can detect the language we speak. The technology (Virtual Assistant) allow students to search for materials, reference questions, articles, and even books by simply speaking or monitoring keywords.

Enhancing Educational Content and Simulations: AI is a technology that has the ability to significantly improve the development of educational content by offering dynamic simulations, virtual labs and interactive exercises. In TVE, AI-based tools can simulate real-world scenarios in areas of skills acquisition, where students can engage with virtual tools that replicate real-life situations. These simulations can help students build practical skills without the logistical constraints of physical resources.

Access to Resources and Equity: AI-powered educational platforms has the capacity to bridge the gap for students in underserved areas who may not have access to fully equipped classrooms. This is crucial in TVE programme, because as online learning is improving, AI technology has the potential to customized effective resources. The Global Partnership for Education (2020) emphasizes that AI can play a pivotal role in creating equitable educational opportunities by offering scalable and affordable solutions to TVE in particular and for education in general.

CHALLENGES OF INTEGRATING AI IN TVE

Despite the numerous opportunities that abound in the application of AI in TVE, the technology still presents several challenges and concerns. Some of the challenges according to Dahlin (2022) includes:

Resource Constrains. The will power and the ability to provide adequate funding to cover the cost of integrating AI in TVE, acquiring and maintaining necessary infrastructure, and ensuring data quality and security can pose serious financial challenges for TVE institutions.

Ethical Concerns and Data Privacy. AI integration raises ethical concerns regarding students' data privacy and the ethical implication of automated assessments, algorithmic bias and the responsible use of AI technologies in TVE, necessitating clear guidelines and oversight mechanism.

Explicability: AI-driven tools, especially deep learning algorithms can be complex, composite and opaque, making it challenging to explain or interpret how decisions are made and potentially compromising the transparency and accountability of the TVE programme.

Skill Gaps: Integrating AI into TVE programme requires specialized technical expertise that may be readily available, necessitating and upskilling initiatives for TVE staff, focusing on both the technical aspects of the AI technologies and the pedagogical application.

Job Displacement: The increase use of AI technology in everyday life raises some concerns about job displacement, particularly in professional occupation. The use of AI may replace the role of humans in teaching and learning, thereby reducing the importance of human interaction for students' social and emotional development.

Digital Divide It appears that there is digital divide between the urban and rural areas, with urban institutions of learning having better internet services than their rural counterparts. Inadequate internet connectivity and lack of digital devices can hinder the integration of AI into TVE, therefore, ensuring access to digital technology and provision of internet services is crucial.

Power supply: Inadequate power supply or frequent power outages can pose a serious challenge, by disrupting internet connectivity, that can affect activities. This kind of problem can be frustrating and discouraging

Curriculum Integration: AI application in education in general and in TVE in particular are still in their infancy, and many existing curricula do not yet incorporate the AI-based learning tool effectively. Developing a curriculum that will align with AI-enhanced TVE programme requires resources, time, effort and coordination between educators, curriculum developers and the policy-makers.

THE NEED FOR A CAUTIOUS AND CRITICAL APPROACH

Artificial Intelligence (AI) revolution is taking place at a dazzling pace. However, the gaze on the dazzles of AI technology must not lose sight on its downside and its deleterious effects. The world which is shifting very fast from analog to digital is exposing humans to vast promise and peril of new technologies that has brought many incredible benefits and challenges. We must therefore, be wary of potentially harmful and pernicious impact of AI on the minds of our children and of the society of today and tomorrow. As such, ample care is necessary by the way of public policies, so that the integration of AI in TVE does not cripple or even compromise the humanistic mission of the TVE programme so as to bring forth the potential in human being and nature, and to also nourish the mental and intellectual faculties with focus on human values. Thus, some of the development in today's technologies and innovations hubs calls for serious concern.

The use of AI in education and TVE in particular is leading to more consumer-oriented attitude in our academic institutions. Therefore, policy makers need to insightfully understand the repercussions of AI in TVE before embracing it. This is crucial considering the fact that while advantages according to TVE by use of AI are publicized, the repercussions and risks involved remain inadequately addressed, and call for proper analyzing the policy implications of the use of

AI technology in terms of what it entails, not only how it can be pernicious if not properly controlled and regulated. In that regard, raising public debate on the role of AI technology in TVE is necessary so as to throw light on the advantages and the risks involved. As such, by integrating AI in TVE, all concern authorities must adopt a cautious and critical approach, guided by the aphorism. Consequently, policy-makers, teachers, and academic institutions need to ensure that AI is utilized in a way that complements human guidance, rather than replacing it entirely. Guszeza, (2022) caution that AI technologies need to be designed to avoid biases and ensure that educational outcomes are fair and beneficial to all.

CONCLUSION

Artificial Intelligence holds considerable potentials in revolutionizing Technology and Vocational Education by offering personalized learning experiences, stimulating real-life tasks, and providing real-time feedback and practical skills. While the potentials of AI in TVE are numerous and undeniable, its successful integration into TVE depends on addressing challenges such as inadequate funding, modern infrastructures, ethical concerns and personnel training. The future of TVE in Nigeria depends on harnessing the AI technologies to create more conducive, dynamic, inclusive and efficient learning environment that empowers learners to develop essential digital life skills for the 21st century job market.

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