# IMPACT OF ARTIFICIAL INTELLIGENCE (AI) UTILIZATION IN TEACHING AND LEARNING VOCATIONAL AND TECHNICAL EDUCATION (VTE) IN BENUE STATE

**Terdoo David Aginde & Jacob Terzulum Dura**
Department of Industrial Technical Education, Joseph Saawuan Tarka University Makurdi

(terdoodavid@gmail.com) 07038385041; (jacobdura4@gmail.com) 08136876161

**Abstract**
The study examined the impact of AI utilization in teaching and learning VTE in Benue State. Three research questions were framed and three null hypotheses were formulated and tested. A descriptive survey research design was adopted for the research. The population for the study comprised a total of 431 VTE graduates registered with the Technical Education Practitioners Association of Nigeria (TEPAN)in Benue State. Krejcie and Morgan table was used to arrive at a sample size of 205 respondents. A stratified sampling technique was employed to ensure respondents across different local government areas of Benue State were well represented. An 18-item instrument was developed by the researcher and validated by three experts was used for data collection. Cronbach's alpha reliability technique used to ascertain reliability of the instrument yielded a coefficient index of .89. Mean and standard deviation were used to answer research questions while chi-square was utilized in testing the null hypotheses. Findings of the study revealed positive impact of AI utilization in teaching and learning VTE in spite of numerous challenges. The study recommended that: Government and relevant stakeholders should invest in VTE training programmes for teachers to develop AI competencies which will be effectively integrated into teaching and learning. Government should initiate and sustain collaborations between educational institutions, industry stakeholders, and technology providers so as to facilitate resource sharing and enhance development of relevant AI applications in VTE. Government through relevant stakeholders should champion the creation and implementation of policies and regulations that support AI integration in teaching and learning VTE in Benue State-Nigeria.

**Keywords:** Intelligence, Artificial Intelligence (AI), Utilization, Teaching and Learning, Vocational and Technical Education (VTE)

## Introduction

Vocational and Technical Education (VTE) plays a crucial role towards equipping individuals with requisite practical skills for specific trades and professions. With the advent of Artificial Intelligence (AI), there is a significant opportunity to transform traditional VTE methodologies, making education more personalized, efficient, and aligned with industry needs. Ejjami (2024) opined that AI's ability to analyze data, predict outcomes, and automate processes presents unique opportunities to enhance both teaching and learning experiences in VTE. It is defined as that aspect of education which leads to the acquisition of practical and applied skills as well as basic scientific knowledge (Ikpe, 2010). Uwaifo (2009) also defined technical education as the training of technically oriented personnel to be the initiators,

facilitators and implementers of technological development of a nation. This implies that VTE deals with the training or retraining designed to prepare individuals to enter into a paid employment in any recognized occupation (Ojimba, 2012). Technical and Vocational Education and Training (TVET), involves educational programmes that prepare individuals for specific trades, crafts and careers at various levels, focusing on the practical applications of skills and knowledge (Pringle, 2024).

Hui (2020) defined AI as computer systems capable of performing tasks that typically require human intelligence, such as reasoning, learning, problem-solving, and decision-making. Although VTE traditionally focused on practical skills, the current labour market require graduates to possess superior digital skills and adaptability to technology which calls for the need to integrate AI into VTE (ILO, 2024). Integrating AI into VTE programmes has become a key focus to bridge this skills gap, creating valuable opportunities to improve practice-based learning while equipping students for AI-driven careers (McKinsey, 2023). The incorporation of AI technologies into VTE is also a powerful catalyst that transforms skills development, student engagement with educational resources and enhance employability.

AI-enabled educational tools that range from sensor-equipped simulators aid in delivering instant feedback in hands-on activities to adaptable learning systems and generative AI helpers to provide unmatched opportunities for customization, prompt support and interaction in vocational skill training (World Economic Forum, 2024). These tools mark a notable improvement over conventional training methods, especially for technical skills that demand considerable practice, accuracy as well as flexibility across different scenarios. AI is changing so many sectors, including education, by shaping the classroom experiences according to individual student needs (Zawacki-Richter, Marín, Bond & Gouverneur, 2019). Reaffirming that learning platforms use AI to examine student's progress and make available learning materials to students. Similarly, Ng, Nicholas, and Williams (2021) asserted that grading of assessments, online teaching and intelligent feed backs are among many advantages of using AI. This reduces the burden and burn out among teachers which enables them to focus more on practical training rather than administrative tasks. AI also promotes safety of hands-on training that could have exposed teachers and learners to unforeseen hazards experienced in physical workshop training (Chen, Xie & Hwang, 2020).

Pan, Zhai, and Li (2021) highlighted AI's role in aligning VTE curricula with emerging industry needs by analyzing job market trends and recommending relevant skills. This showed AI-powered systems' ability to support the reskilling and upskilling process of workers to

match technological advancements. Additionally, Zawacki-Richter et al. (2019) supported the view that AI-driven translation and speech recognition tools improves accessibility for different learners simultaneously, including those with disabilities. These insights suggest that AI, if properly harnessed, can significantly raise the impact of VTE in Benue State.

Despite AI's numerous benefits for VTE, Selwyn (2019) noted that its adoption requires significant investment in infrastructure, training and software development, which may not be feasible for all institutions. Ng et al. (2021) also affirmed that many VTE teachers lack adequate AI literacy, this makes it difficult to incorporate AI-driven tools effectively for teaching and learning. This indicates that funding and teacher inefficiency in AI utilization pose significant challenges to its integration into VTE.

Chen et al. (2020) emphasized that AI systems collect and analyze vast amounts of student data, this raises concerns about privacy and ethical considerations when handling such data. Similarly, Pan et al. (2021) warned that an over-reliance on AI is likely to decrease traditional hands-on learning experiences, which are critical for VTE. Disparities in access to AI-driven educational tools also widen the gap between students from different socio-economic backgrounds (Selwyn, 2019). These challenges highlight the need for strategic interventions to ensure AI's positive impact on VTE. Schmid, Rautenbach, and Ziegler (2021) suggested that partnership between governments, industries, and educational institutions can go along way to improve the funding of AI-based VTE programmes, thereby, reducing financial burdens on schools. Jin, Kim, and Xu (2022) insisted that institutions can adopt open-source AI tools and software as this approach will reduce costs while giving high-quality educational resources. Additionally, governments and institutions should set up AI training programmes for VTE teachers to intensify their competency. AI-related courses should be incorporated into teacher education programmes to train future teachers for AI-driven instruction. AI-based training systems can also support teachers in understanding AI applications in education while improving teaching efficiency (Pan et al., 2021; Ng et al., 2021; Chen et al., 2020).

Lourdu (2025) advocated that using AI solutions is important in preserving student's data from outsiders. Pan et al. (2021) also emphasized that combining AI-driven instruction with practical, hands-on training is a good strategy to enable students acquire requisite theoretical knowledge and practical skills needed to succeed in VTE. It suffices to say that AI-powered Virtual Reality (VR) and Augmented Reality (AR) tools complement physical training with the core aim of improving teaching and learning of VTE (Chen et al., 2020). According to Lourdu (2025), enacting policies that support the provision and utilization of AI

tools in teaching VTE in under-served areas through subsidies, grants and infrastructure development should be prioritized and sustained so as produce globally competitive graduates of VTE. Furthermore, provision of low-cost devices such as: Computers and internet connectivity in rural areas should be improved to enhance AI adoption in VTE. This shows that establishing AI resource centers in local communities would enable students from different socio-economic backgrounds have equal access to AI-driven learning tools (Schmid et al., 2021; Jin et al., 2022). If these strategies are implemented, the impact of AI on VTE in Benue State will be significant, promoting innovation, accessibility and efficiency in the teaching and learning of VTE.

**Statement of the Problem**

Despite the critical impact of VTE in workforce development, traditional teaching methods often attempt to keep pace with rapidly evolving industry requirements. For VTE graduates to remain relevant in the labour market, there is need to upscale their digital skills using AI in addition to their area of specialty. Sadly, most students lack adequate knowledge in the use of AI which limit their chances to more opportunities. Acquiring AI knowledge in addition to VTE skills will bridge this skills gap thereby creating valuable opportunities to improve practice-based learning and equip students for AI-driven careers. Institutions of learning are continuously prioritizing the incorporation of AI technologies into VTE so as to transforms skills development, enhance student engagement with educational resources and enhance employability, yet reasonable win have not been achieved yet. Government through relevant stakeholders have prioritized the training and retraining of VTE teachers on the use of AI tools so as to achieve notable improvement over conventional training methods especially for technical skills that demand considerable practice, accuracy as well as flexibility across different scenarios. Yet the level of impact is yet to be ascertained, it is to this end that the study investigates the impact of AI utilization in teaching and learning VTE in Benue State.

**Purpose of the Study**

This study investigates the impact of AI utilization in teaching and learning VTE. Specifically, the study determines the:

1. Impact of AI utilization for teaching and learning of VTE in Benue State.
2. Challenges affecting AI utilization for teaching and learning VTE in Benue State.

3. Strategies employed to address challenges affecting AI utilization for teaching and learning VTE in Benue State.

**Research Questions**

The study was guided by the following research questions:

1. To what extent does AI utilization impacts on teaching and learning of VTE in Benue State?
2. What are the challenges that affect AI utilization for teaching and learning VTE in Benue State?
3. What strategies can be employed to address the challenges of AI utilization for teaching and learning VTE in Benue State?

**Hypotheses**

The following null hypotheses were formulated and tested at 0.05 level of significance:

1. There is no significant difference in mean response of respondents on the impact of AI utilization for teaching and learning VTE in Benue State.
2. There is no significant difference in mean response of respondents on the challenges affecting AI utilization for teaching and learning VTE in Benue State.
3. There is no significant difference in mean response of respondents on the strategies employed in addressing challenges of AI utilization for teaching and learning VTE in Benue State.

**Theoretical Framework**

**Technology Acceptance Model (TAM)**

The Technology Acceptance Model (TAM) developed by Davis (1989) states that: "Technology is more acceptable when users perceive it to be useful and easy to use, this influences their willing and creates a positive attitude toward using it". The model explains that two primary factors determine technology acceptance:

**Perceived Usefulness (PU):** The level to which a user believes that using a particular technology will enhance their job performance.

**Perceived Ease of Use (PEOU):** The level to which a user believes that using the technology will be free of effort.

This model is linked to the present study because VTE teachers and students may find AI useful if it intensifies educational efficiency, provides real-time feedback and supports individualized

knowledge acquisition which aligns with practical skill development. The model also relates to this study because, if AI tools are user-friendly and require less technological skills to operate, users will be more likely to adapt it into teaching and learning of VTE.

## Methodology

This study adopted a descriptive survey research design using a population of 431 VTE graduates registered with the Technical Education Practitioners Association of Nigeria (TEPAN). Krejcie and Morgan's table was used to arrive at a sample size of 205 respondents. A stratified sampling technique was employed to ensure a good representation across different local government areas of Benue State are well represented. A 15 item research questionnaire titled: Impact of Artificial Intelligence in Teaching and Learning Vocational and Technical Education Questionnaire (IAITLVTEQ) was developed by the researchers on a 4-point rating scale of: Strongly Agree=4, Agree=3, Disagree=2 and Strongly Disagree=1. The instrument was validated and subjected to reliability testing using the Cronbach's Alpha reliability technique which yielded a reliability index of .89. The instrument was then used for data collection through direct contact and with the aid of two research assistants. Data collected was analyzed using mean and standard deviation to answer research questions while Inferential Chi-Square was used to test the null hypotheses at 0.05 level of significance. Items with 2.50 and above were agreed while items with 2.49 and below were disagreed using the grand mean. The p and α values were also compared. If $p > \alpha$, the null hypothesis was accepted, if $p < \alpha$, the null hypothesis was rejected. Data was analyzed using Statistical Package for the Social Sciences (SPSS) Version 27.

## Results

Data collected was analyzed and presented in the tables according to research questions and hypotheses:

### Research Question One

To what extent does AI utilization impact teaching and learning of VTE in Benue State?

**Table 1: Mean and Standard Deviation on the Impact of AI on Teaching and Learning VTE in Benue State**

| S/No | Items | N | M | SD |
|---|---|---|---|---|
| 1 | AI improves personalized learning in Vocational and Technical Education (VTE) | 205 | 3.81 | .55 |

| | | | | |
|---|---|---|---|---|
| 2 | AI-powered simulations effectively enhance students' practical skills in VTE | 205 | 3.72 | .79 |
| 3 | AI improves the efficiency of teaching and administrative processes in your VTE institutions | 205 | 3.63 | .89 |
| 4 | AI utilization contributes to curriculum development based on industry trends in VTE | 205 | 3.32 | 1.15 |
| 5 | AI-enhanced accessibility benefits students with disabilities and diverse linguistic backgrounds in VTE | 205 | 3.74 | .85 |
| 6 | AI contributed to student engagement in learning VTE-related subjects | 205 | 3.72 | .79 |
| | **Grand Mean** | | **3.66** | **.84** |

Table 1 above showed respondents' perception on the impact of AI utilization in teaching and learning of VTE. The data revealed a mean score of 3.66 and a low standard deviation of .84, signifying that the responses were clustered around the mean. This implies that AI utilization has a significant impact on the teaching and learning of VTE in Benue State-Nigeria.

**Research Question Two**

What are the Challenges that affect AI Utilization for Teaching and Learning VTE in Benue State?

**Table 2: Mean and Standard Deviation on the Challenges that Affect AI Utilization for Teaching and Learning VTE in Benue State-Nigeria**

| S/No | Items | N | M | SD |
|---|---|---|---|---|
| 7 | Adoption of AI in VTE requires significant investment in infrastructure that is not feasible for all institutions | 205 | 3.51 | .93 |
| 8 | VTE teachers lack adequate AI literacy | 205 | 3.22 | 1.22 |
| 9 | Students' data privacy is a challenge since AI systems handle vast amounts of student data | 205 | 3.81 | .66 |
| 10 | Over-reliance on AI may reduce traditional hands-on learning experiences in VTE | 205 | 3.28 | .91 |
| 11 | Using AI-driven educational tools can widen the gap between students from different socio-economic backgrounds | 205 | 4.00 | .00 |
| 12 | High cost is required for AI software development that most schools cannot afford | 205 | 3.51 | .93 |
| | **Grand Mean** | | **3.56** | **.78** |

Table 2 above showed respondents' perception of the challenges that affect AI utilization for teaching and learning VTE. The data revealed a mean score of 3.56 and a low standard deviation of .78, signifying that the responses were clustered around the mean. This implies that challenges such as: High cost of funding AI in VTE, lack of adequate literacy among VTE teachers, poor data privacy policy, over-reliance on AI, and increasing the gap between

students from different socio-economic backgrounds affect the positive impact of AI utilization for teaching and learning VTE in Benue State, Nigeria.

**Research Question Three**

What Strategies can be employed to address the Challenges of AI Utilization for Teaching and Learning VTE in Benue State?

**Table 3: Mean and Standard Deviation on the Strategies Employed to Address the Challenges of AI Utilization for Teaching and Learning VTE in Benue State**

| S/No | Items | N | M | SD |
|---|---|---|---|---|
| 13 | Collaborations with VTE stakeholders can help fund AI-based VTE programmes | 205 | 3.39 | 1.03 |
| 14 | Adopting open-source AI tools/software will reduce costs while providing high-quality educational resources | 205 | 3.05 | 1.11 |
| 15 | Provide AI training programmes for VTE teachers to enhance their AI competency | 205 | 3.30 | 1.03 |
| 16 | The use of privacy-preserving AI solutions will protect student data from misuse | 205 | 4.00 | .00 |
| 17 | Combining AI-driven instruction with practical, hands-on training will help students acquire both all aspects of VTE | 205 | 3.71 | .65 |
| 18 | Policies should target expansion of AI access to rural areas through infrastructure development | 205 | 3.30 | 1.03 |
| | **Grand Mean** | | **3.46** | **.81** |

Table 3 above showed respondents' perception of the strategies adopted to address the challenges that affect AI utilization for teaching and learning VTE. The data revealed a mean score of 3.46 and a low standard deviation of .81, signifying that the responses were clustered around the mean. This implies that strategies such as: Collaborations to fund AI-based VTE programmes, adopting open-source AI tools/software to reduce costs, providing AI training programmes for VTE teachers to enhance their AI competency, use of privacy-preserving AI solutions to protect student data from misuse, combining AI-driven instruction with practical, hands-on training to help students acquire both all aspects of VTE and implementing policies that target expansion of AI access to rural areas through infrastructure development will address challenges of AI utilization in teaching and learning VTE in Benue State, Nigeria.

**Hypothesis One**

There is no Significant Difference in mean response of Respondents on the Impact of AI Utilization for Teaching and Learning VTE in Benue State.

**Table 4: Chi-Square Analysis on the Impact of AI Utilization for Teaching and Learning VTE in Benue State**

| Respondents | N | χ2 | df | p | α | Remark |
|---|---|---|---|---|---|---|
| VTE Graduates | 205 | 214.06 | 23 | .00 | .05 | **p<.05 Significant** |
| **Total** | **205** | | | | | |

Table 4 showed a statistically significant positive impact of AI utilization in teaching and learning VTE $\chi^2$ (df=23, N = 205) = 214.06, p = .00 < α = .05. Therefore, the null hypothesis was rejected. This means that AI utilization has a positive impact on the teaching and learning of VTE in Benue State.

**Hypothesis Two**

There is no Significant Difference in mean response of Respondents on the Challenges affecting AI utilization for teaching and learning VTE in Benue State.

**Table 5: Chi-Square Analysis on the Challenges affecting AI Utilization for Teaching and Learning VTE in Benue State**

| Respondents | N | χ2 | df | p | α | Remark |
|---|---|---|---|---|---|---|
| VTE Graduates | 205 | 109.24 | 37 | .03 | .05 | **P<.05 Significant** |
| **Total** | **205** | | | | | |

Table 5 showed a statistically significant difference in the challenges affecting AI utilization for teaching and learning VTE $\chi^2$ (df=37, N = 205) = 109.24, p = .03 < α = .05. Therefore, the null hypothesis was rejected. This means that respondents differ in opinion that challenges such as: High cost of funding AI in VTE, lack of adequate literacy among VTE teachers, poor data privacy policy, over-reliance on AI, and increasing the gap between students from different socio-economic backgrounds affect the positive impact of AI utilization for teaching and learning VTE in Benue State-Nigeria.

**Hypothesis Three**

There is no Significant Difference in mean response of Respondents on the strategies employed in addressing challenges of AI utilization for teaching and learning VTE in Benue State.

**Table 6: Chi-Square Analysis on the Strategies Employed to Address Challenges of AI Utilization for Teaching and Learning VTE in Benue State**

| Respondents | N | χ2 | df | p | α | Remark |
|---|---|---|---|---|---|---|
| VTE Graduates | 205 | 342.07 | 17 | .00 | .05 | **p<.05 Significant** |
| **Total** | **205** | | | | | |

Table 5 showed a statistically significant difference in the strategies employed to address challenges of AI utilization for teaching and learning VTE $\chi^2$ (df=17, N = 205) = 342.07, p = .00 < α = .05. Therefore, the null hypothesis was rejected. This means that respondents differ in opinion that strategies such as: Collaborations to fund AI-based VTE programmes, adopting open-source AI tools/software to reduce costs, providing AI training programmes for VTE teachers to enhance their AI competency, use of privacy-preserving AI solutions to protect student data from misuse, combining AI-driven instruction with practical, hands-on training to help students acquire both all aspects of VTE and implementing policies that target expansion of AI access to rural areas through infrastructure development will address challenges of AI utilization in teaching and learning VTE in Benue State-Nigeria.

**Discussion of Findings**

The findings of the study revealed that AI utilization positively impacts on teaching and learning of VTE. This is in line with the position of Selwyn (2019) who insisted that AI facilitates adaptive learning systems and tailors it to individual student needs. The findings also collaborate the view of Zawacki-Richter et al. (2019) who noted that AI-driven platforms shape learning experiences and adjusts educational content accordingly to meet students varying abilities. This equally affirmed the position of Ng et al. (2021) who stated that AI helps in automated grading, virtual tutors, and intelligent feedback that help to reduce workload for teachers. The findings are similar with that of Chen et al. (2020) who agreed that the use of AI tools offer safe, convenient and cost-effective alternatives for skill acquisition. This is related with the thought of Pan et al. (2021) who affirmed that AI adequately prepares graduates with globally accepted VTE skills. This means that AI utilization positively impacts on teaching and learning of VTE in Benue State.

Findings from the study also showed that challenges affecting the utilization of AI in teaching and learning of VTE include: High cost of funding AI in VTE, lack of adequate literacy among VTE teachers, poor data privacy policy, over-reliance on AI, and increasing the gap between students from different socio-economic backgrounds. This is related to the view

of Selwyn (2019) who echoed that AI integration is less accessible for underfunded institutions. The study also linked with the findings of Ng et al. (2021) who insisted that many VTE teachers lack skills to integrate AI tools effectively into teaching and learning processes. The study also reflects the view of Chen et al. (2020) who reaffirmed that AI-driven systems poses a risk to student's data privacy and security. Findings from the study equally links with that of Pan et al. (2021) who belaboured that AI-based simulations reduces practical learning experiences that is crucial for VTE programmes. The study equally reflected the submission of Zawacki-Richter et al. (2019) who insisted that due to social-economic disparity, not all students are able to access AI-driven learning tools. This point to the fact that addressing the challenges using: Adequate VTE funding towards AI utilization, using AI to train VTE teachers, good policy on data privacy will position Benue State on the world map on producing graduates who meet global standards.

Findings from the study affirmed that strategies such as: Collaborations to fund AI-based VTE programmes, adopting open-source AI tools/software to reduce costs, providing AI training programmes for VTE teachers to enhance their AI competency, use of privacy-preserving AI solutions to protect student data from misuse, combining AI-driven instruction with practical, hands-on training to help students acquire both all aspects of VTE and implementing policies that target expansion of AI access to rural areas through infrastructure development, are the strategies for implementing AI in VTE teaching and learning. This is related to the submission of Schmid et al. (2021) who insisted that public-private partnerships (PPP) and open-source AI tools can help institutions overcome financial barriers. This affirmed the position of Jin et al. (2022) who stressed that cloud-based AI solutions can reduce hardware costs. This also collaborates the findings of Ng et al. (2021) and Chen et al. (2020) who noted that teacher training schools should adopt AI for preparing teachers. The findings also align with that of Selwyn (2019) who advocated for institutional policies that enforce the use of AI. Findings from the study also affirmed the queue of Pan et al. (2021) who insisted that the use of AI prepares students to acquire both theoretical and applied skills. This also fits like the that of Schmid et al. (2021) who reiterated the provision of AI infrastructure for underprivileged areas as a step towards inclusivity. This implies that the aforementioned strategies will address challenges affecting AI utilization in teaching and learning VTE in Benue State.

## Conclusion

The study revealed through conceptual and theoretical framework as well as result from data analysis that AI significantly impact on VTE, particularly in personalized learning, automation, skill training and industry alignment. However, challenges such as cost, educator preparedness, ethical concerns and digital inequalities must be addressed to ensure effective AI implementation. Through strategic interventions, AI can be harnessed to transform VTE, making it more efficient, accessible and aligned with future workforce needs in Benue State-Nigeria.

## Recommendations

The study recommended that:

1. Government and relevant stakeholders should invest in the purchase and utilization of AI equipment for teaching VTE so as to achieve and sustain its impact.
2. Government and relevant stakeholders should set up a monitoring and evaluation team to constantly supervise the utilization of AI equipment used for teaching and learning VTE in Benue State.
3. Government through relevant stakeholders should champion the creation and implementation of policies and regulations that support AI integration in teaching and learning VTE in Benue State, Nigeria.

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