INVESTIGATING THE ROLE OF ARTIFICIAL INTELLIGENCE IN ENHANCING STUDENTS' ENGAGEMENT AND MOTIVATION IN ONLINE LEARNING IN TVET INSTITUTIONS IN SOUTHWEST NIGERIA

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Abstract

The study investigated the role of artificial intelligence (AI) in enhancing students' engagement and motivation in online learning in TVET institutions in Southwest Nigeria. The study adopted a descriptive survey design. Three research questions guided the study, while three null hypotheses formulated were tested at 0.05 level of significance. The study was conducted across eight TVET institutions in southwest Nigeria. The target population comprised lecturers, instructors, and students from these institutions. A random sampling technique was employed to select a total sample of 586 respondents. This sample consisted of 75 lecturers, 58 instructors, and 453 students. Standardized questionnaires were adapted and used to collect data for the study. The Cronbach Alpha reliability test, which produced a reliability index of $\alpha = 0.90$, was used to determine the internal consistency. Data collected were analyzed using mean and standard deviation for answering the research questions, while the null hypotheses were tested using analysis of variance (ANOVA) at 0.05 level of significance. Based on the data analyzed, the findings revealed that AI tools such as virtual tutors, personalized content delivery, automated feedback systems, and gamified learning platforms significantly improve students' learning experiences by increasing their engagement and motivation. However, the study also revealed several institutional limitations that hinder the full incorporation of AI in TVET education. These include inadequate infrastructure, limited access to AI tools, and insufficient staff training. The analysis further showed statistically significant differences in perceptions between students and educators on the benefits of AI, while there was a collective concern across all groups regarding implementation challenges. The study recommends improving digital infrastructure, training educators on AI integration, and increasing institutional access to AI tools.

Keywords: Artificial Intelligence (AI), Student Engagement, Motivation, Online Learning and TVET Institutions

Introduction

Artificial Intelligence (AI) has gained substantial traction in education, particularly in Technical and Vocational Education and Training (TVET) institutions. This trend is evident in Southwest Nigeria, where TVET institutions are increasingly adopting online learning platforms to extend access, often through hybrid models (Ayouni et al., 2021). AI, which can be described as machines performing tasks that typically require human intelligence (Ahmad et al., 2022), encompasses a range of tools like ChatGPT, Perplexity, Consensus, and Gemini (Leiter et al., 2024; Owan et al., 2023). These tools provide swift responses and solutions to academic tasks (Venkatesh, 2022). The literature demonstrates AI's significant potential.

Rehman and Kang (2024) stated that AI-based education transforms teaching methodologies globally. Studies showed that students prefer AI for individualized learning (Bagunaid et al., 2022) and that it enables effective teacher-learner collaboration (Shah et al., 2024). Chen et al. (2020) underscored its role in providing instructors with personalized instructional tools. Specifically, in TVET, Saqlain (2023) highlighted its impact even in systems with budget constraints, while Ahmad et al. (2023) emphasized its transformative role in preparing students for modern workplace complexities. Despite this documented potential and global progress, a critical gap remains. The exact influence of AI on student engagement and motivation, especially within the specific socio-economic and infrastructural context of online learning in Southwest Nigeria's TVET institutions, is unclear and understudied.

Student engagement is generally viewed as a significant influence in academic achievement, influencing everything from course completion rates to long-term retention of knowledge. Engagement denotes the extent to which students are actively involved in the learning process psychologically (Meria et al., 2024). Highly engaged students are more likely to participate in deliberations, seek support when needed, and persist through challenges, leading to better academic outcomes. Fernandez et al. (2024) define student engagement as the level of interest, participation and motivation a student demonstrates in the learning process, which is highly central to the success of online learning in TVET institutions. Hasanov et al. (2021) identify three dimensions of engagement: behavioural engagement, which relates to involvement in academic and societal activities; emotional engagement, which refers to students' feelings towards the learning experience; and cognitive engagement, concerned with the depth of the student's investment in learning (Wahyudi et al., 2023). The challenge of promoting student engagement has been aggravated in online and hybrid learning environments, where physical distance between students and educators can create barriers to collaboration and motivation (Faridah et al., 2020). AI-driven adaptive learning systems offer a promising solution by utilizing real-time data to monitor engagement levels and intervene when needed. For instance, AI systems can recognize students who are struggling or disengaged by analysing patterns such as reduced involvement, longer response time, or poor performance in assessments. Once identified, the system can automatically regulate the learning content or provide additional support to re-engage the student. Studies such as Bennet et al. (2024), suggested that such adaptive interventions, when provided in a timely manner, can significantly enhance engagement and academic performance. AI-powered learning, particularly Deepseek, ChatGPT and other versatile AI tools, is a potential tool for enhancing

students' behavioural, psychological and cognitive engagement in online learning settings. It may motivate students' critical thinking to assess their all-inclusive understanding of their learning activities, leading to self-regulated behaviour (Kuraku et al., 2023). Student engagement may represent a visible indicator of deeper student motivation.

Motivation is an important factor that drives student engagement, which is highly required of TVET students in order to be successful in any chosen trade or vocation. Motivation, according to Rizvi (2023), is a multidimensional concept that initiates individuals to act and persist in achieving their goals. Student motivation is an important issue in technical education because it serves as a driving factor that enables students to complete goal-oriented educational tasks (Lo et al., 2023). To understand how AI can be used to strengthen student motivation during specialized instruction, some theoretical frameworks have been developed including Self-Determination Theory (SDT) and Expectancy-Value Theory (EVT). SDT outlines the innate psychological needs for autonomy, competence, and relatedness which must be fulfilled for an individual to experience intrinsic motivation, engagement, and well-being (Fazlollahi et al., 2022). Many AI-powered technologies contain inherent features that can provide TVET students with autonomy by allowing them to customize learning pathways based on their own motivation and enthusiasm. The use of AI in enhancing student motivation during professional formation is booming and highly encouraging in the field of education (Rizvi, 2023). Incorporating motivation and social engagement AI tools in TVET provides interesting benefits for cooperation, interface, and collaborative learning. Leveraging cutting-edge algorithms to connect TVET students with shared motivation can encourage collaborative engagement in TVET institutions while promoting active involvement among students and educators alike. Paek and Kim (2021) inferred this much when they stated that through virtual classrooms, online forums, and other platforms powered by AI-driven technologies, individuals can engage in collaborative discourse while developing essential social-emotional skills such as empathy and proficient communication. Previous studies, according to Rehman and Kang (2024), have shown that many students are disinterested and have low academic engagement in online learning owing to feelings of isolation, educational motivation deficit, a lack of dynamic and spontaneous connection, and so on. The critical role that AI-powered technologies, including tools such as ChatGPT, Consensus, Perplexity, and DeepSeek, can contribute to enhancing online learning within TVET institutions cannot be overstated. Ahmad et al., (2023) submitted that AI-powered technologies have the potential to enhance learners'

individualized learning by encouraging academic engagement and motivation within the context of self-directed distant teaching-learning progression.

Online learning, often known as remote learning, is the transfer of educational information and instructions via the Internet, including web-based courses, video and audio conferencing, and individualized education programs (Martin & Borup, 2022). Technical and Vocational Education and Training (TVET) institutions in Southwest Nigeria are increasingly adopting online learning platforms. Higher institutions, according to Ayouni et al. (2021), have adopted online learning to extend access and increase efficiency by offering hybrid classroom and online learning. Online learning environments can be synchronous (formal), asynchronous (informal), or a combination of both (blended or hybrid) online learning and teaching experiences, as well as interactions between students and facilitators (Fitria, 2023). Digital development enables educational institutions to build a workforce of empowered instructors capable of efficiently navigating the digital world and educating learners for the challenges of the twenty-first century (Saeed & Kang, 2024). Informal and formal online learning using AI technology enables the gathering and application of vast amounts of information within student groups (Du et al., 2023). Artificial Intelligence tools with blended online learning procedures showed varied inherent TVET education potentials, including improved learning outcomes, increased student engagement, and motivation. Previous studies have shown that many students are disinterested in and have low academic engagement in online learning owing to feelings of seclusion, absence of educational motivation, a lack of dynamic and spontaneous connection (Rehman and Kang, 2024; Bedi, 2023). In Southwest Nigeria, TVET institutions are increasingly adopting online learning platforms to expand access. However, student engagement and motivation remain critically low, a problem exacerbated by well-documented infrastructural deficits and socio-economic constraints, which often lead to concerning dropout and low completion rates (Olatoye et al., 2021; Afolabi, 2021). While globally, Artificial Intelligence (AI), often in the form of adaptive learning systems and intelligent tutors, has shown promise in personalizing education and mitigating such challenges, its application within the Nigerian TVET sector is nascent and critically understudied. Preliminary studies on EdTech in Nigeria highlight significant potential but also underscore a gap in context-specific AI implementations, noting that technological adoption must be approached with an awareness of local constraints like unstable internet and power supply (Okai et al., 2023; Adewale et al., 2023). Therefore, this study seeks to investigate the role of contextually feasible AI tools in

promoting student engagement and motivation within online learning environments in TVET institutions across Southwest Nigeria.

Research Questions

The following research questions were formulated to guide the study:

1. To what extent does AI enhance students' engagement in online learning in TVET institutions in Southwest Nigeria?
2. How does AI affect students' motivation in online learning environments in TVET institutions in Southwest Nigeria?
3. What are the challenges of implementing AI in online learning in TVET institutions in Southwest Nigeria?

Hypotheses

Based on the specific purposes of the study, the following hypotheses were formulated and tested at $p<0.05$ level of significance.

1. There is no significant difference in the mean responses of lecturers, instructors and students on the extent to which AI enhances students' engagement in online learning in TVET institutions in Southwest Nigeria.
2. There is no significant difference in the mean responses of lecturers, instructors and students on how AI affects students' motivation in online learning environments in TVET institutions in Southwest Nigeria.
3. There is no significant difference in the mean responses of lecturers, instructors and students on the challenges of implementing AI in online learning in TVET institutions in Southwest Nigeria.

Methodology

A descriptive survey design was utilized in this study. Creswell (2014) described descriptive survey design as a design used to collect data to describe trends, attitudes, or behaviours of a population by studying a sample using structured instruments such as interviews or questionnaires. Therefore, this design was found suitable for this study as it optimally facilitates the collection of quantitative data from a representative sample of TVET students and educators with respect to their experiences with AI tools in online learning. These include 586 respondents comprising 75 lecturers, 58 instructors and 453 students from eight TVET institutions in southwest Nigeria namely; Adekunle Ajasin University, Akungba Akoko, Ondo State, Ekiti State University (EKSU), Ado-Ekiti, Ekiti State, Bamidele Olumilua University of Education, Science and Technology (BOUESTI), Ikere-Ekiti, Ekiti State, Tai

Solarin University of Education (TASUED), Ijagun, Ogun State, Olabisi Onabanjo University (OOU), Ago-Iwoye, Ogun State, Obafemi Awolowo University (OAU), Ile-Ife, Osun State, University of Lagos (UNILAG), Lagos State and Lagos State University of Education, Oto/Ijanikin, Lagos State. The selected TVET institutions were chosen based on the availability of TVET courses in Southwest Nigeria. Random sampling techniques was utilized to sample the respondents.

The instrument for data collection is a standardized questionnaire titled AI in TVET Engagement and Motivation Scale (AITEMS). The instrument has two sections, A and B. Section A were used to collect demographic information such as institution, course of study, gender and age, while Section B comprises the following three instruments: Online Student Engagement Scale (OSES) adapted from Dixson (2015); Motivation Scale for Online Learning (MSOL) adapted from Hartnett (2016); and Technology Acceptance Model (TAM) Questionnaire adapted from Davis (1989). The scales were modified to incorporate AI-specific variables and local contextual factors while preserving their original measurement structures. The adaptations targeted AI-enhanced learning processes and institutional barriers relevant to Southwest TVET institutions. The instrument was face-validated by three experts from three TVET institutions in southwest Nigeria. The overall Cronbach Alpha reliability test, which produced a reliability index of $\alpha = 0.90$, was used to determine the internal consistency. Data collected were analyzed using mean for answering the research questions, while the null hypotheses were tested using analysis of variance (ANOVA) at 0.05 level of significance. In deciding on the research questions, real limit was utilized as follows: any item with mean value within the real limit of 4.50-5.00 (Strongly Agree); 3.50-4.49 (Agree); 2.50-3.49 (Undecided); 1.50-2.49 (Disagree); 1.00-1.49 (Strongly Disagree) with corresponding numerical values of 5, 4, 3, 2 and 1, respectively. The null hypotheses of no significant difference in the mean ratings of the respondents were accepted for items whose p-values are greater than 0.05 level of significance while the null hypotheses of no significant difference were rejected for items whose p-values were less than 0.05 level of significance. All the computations were done using the SPSS Version 26.

Results

The results are presented in tables based on the research questions and hypotheses that guided the study.

Table 1
Mean Responses of Respondents on the Extent to Which AI Enhances Students' Engagement in Online Learning in TVET Institutions in Southwest Nigeria

S/N	Item Statements	$\bar{X}$	SD	Remarks
1	AI-powered tools help me understand course content better.	4.21	0.77	Agreed
2	AI-generated quizzes improve my critical thinking.	4.18	0.84	Agreed
3	I study more when AI personalizes learning materials.	3.96	0.88	Agree
4	AI discussion prompts increase my online contributions.	4.09	0.81	Agree
5	I complete more assignments with AI reminders.	4.33	0.74	Agree
6	AI group project suggestions enhance collaboration.	3.89	0.85	Agree
7	I feel more interested when AI designs content to my style.	4.22	0.79	Agree
8	AI feedback makes me more confident.	4.12	0.83	Agree
9	AI virtual tutors reduce my frustration.	4.28	0.78	Agree
10	AI tools make online learning more engaging.	4.35	0.73	Agree
11	I would recommend AI-enhanced courses.	4.41	0.69	Agree

Data presented in Table 1 revealed that all the items had their mean value ranged from 3.89 to 4.41. Each of these mean values is above the cut-off point of 3.50, indicating that all AI-related strategies in the table were perceived by the respondents as effective in enhancing student engagement. The standard deviation (SD) values for these items ranged from 0.69 to 0.88, all of which are below the 1.96 threshold for a 96% confidence level. This implies that the respondents were fairly consistent in their opinions and that their responses were close to the mean values. This consistency in responses adds credibility to the reliability of the mean ratings.

Table 2
Mean Responses of Respondents on the Extent to Which AI Affect Students' Motivation in Online Learning Environments in TVET Institutions in Southwest Nigeria

S/N	Item Statements	$\bar{X}$	SD	Remarks
1	Online learning is more enjoyable with interactive AI tools.	4.23	0.80	Agree
2	AI-personalized paths increase subject interest.	4.19	0.77	Agree
3	AI virtual tutors make difficult topics easier.	4.35	0.75	Agree
4	AI reminders help me stay on track.	4.44	0.69	Agree
5	Competing with AI-ranked peers motivates me.	3.91	0.91	Agree
6	AI dashboards motivate me to improve.	4.11	0.86	Agree
7	AI feedback helps me set better learning goals.	4.26	0.74	Agree
8	AI-recommended task skills increase my motivation.	4.32	0.78	Agree
9	AI-simulated tasks prepare me for employment.	4.15	0.85	Agree
10	AI increases my motivation to participate.	4.38	0.72	Agree

Data presented in Table 2 revealed that all the items had their mean value ranged from 3.91 to 4.44. All means were above the cut-off point of 3.50, indicating that the respondents agreed that the AI tools and interventions listed were effective in increasing student motivation for online learning. Standard deviation values ranged from 0.69 to 0.91, all of which are well within the acceptable range under the 96% confidence limit (1.96). This indicates a relatively high level of agreement among the respondents and that their responses were not widely dispersed from the mean. These results strengthen the reliability of the conclusions drawn from the mean scores.

Table 3
Mean Responses of Respondents on the Challenges and Limitations of Implementing AI in Online Learning in TVET Institutions in Southwest Nigeria

S/N	Item Statements	$\bar{X}$	SD	Remarks
1	AI tools improve practical skills training.	4.07	0.84	Agree
2	AI-driven simulations are effective for hands-on learning.	4.01	0.86	Agree
3	AI platforms are easy to navigate.	3.66	0.91	Agree
4	I receive adequate training on AI tools.	2.98	0.93	Undecided
5	My institution has a reliable internet/power supply.	2.74	1.05	Undecided
6	Instructors are proficient in AI integration.	2.89	0.99	Undecided
7	My institution can afford AI tools.	2.65	1.03	Undecided
8	Students resist using AI for technical skill learning.	3.23	0.97	Undecided

Data presented in Table 3 revealed that all the items had their mean value ranged from 2.65 to 4.07. While items 1, 2, and 3 had means above the 3.50 cut-off, suggesting agreement on their positive aspects, the remaining five items had mean values below 3.50, indicating that respondents were undecided or perceived challenges in those areas, particularly with training, infrastructure, instructor proficiency, and affordability of AI tools. Standard deviation values ranged from 0.84 to 1.05, which are all below 1.96, further indicating that the respondents' opinions were not widely varied and that their responses were fairly consistent around the mean. This supports the dependability of the data and emphasizes that while AI's benefits are acknowledged, implementation challenges persist.

Testing of Hypotheses

Table 4: Analysis of Variance (ANOVA) of the Mean Responses of Lecturers and Students on the Extent to Which AI Enhances Students' Engagement in Online Learning in TVET Institutions in Southwest Nigeria

Source of Variance	Sum of Squares	DF	Mean Squares	F-Cal	F-Tab	P-Value	Sig. Level	Remarks
Between Groups	3.72	2	1.86	4.27	3.00	0.015	0.05	Significant Diff.
Within Groups	253.16	583	0.43					
Total	256.88	585						

Data presented in Table 4 revealed a P-value of 0.015, which is less than the 0.05 level of significance at a degree of freedom of 2 and 583. This indicates that there is a statistically significant difference in the mean responses of the three groups regarding the role of AI in student engagement. Therefore, the null hypothesis of no significant difference was rejected.

Table 5: Analysis of Variance (ANOVA) of the Mean Responses of Lecturers and Students on How AI Impact Student's Motivation in Online Learning Environments in TVET Institutions in Southwest Nigeria

Source of Variance	Sum of Squares	DF	Mean Squares	F-Cal	F-Tab	P-Value	Sig. Level	Remarks
Between Groups	2.89	2	1.45	3.62	3.00	0.028	0.05	Significant Diff.
Within Groups	233.41	583	0.40					
Total	236.30	585						

Data presented in Table 5 revealed that the P-value is 0.028, which is also less than the 0.05 significance level at the same degree of freedom. This suggests that there is a significant difference in the mean responses of lecturers, instructors, and students on how AI enhances motivation. Consequently, the null hypothesis of no significant difference was rejected for this item as well.

Table 6: Analysis of Variance (ANOVA) of the Mean Responses of Lecturers and Students on the Challenges and Limitations of Implementing AI in Online Learning in TVET Institutions in Southwest Nigeria

Source of Variance	Sum of Squares	DF	Mean Squares	F-Cal	F-Tab	P-Value	Sig. Level	Remarks
Between Groups	1.94	2	0.97	1.88	3.00	0.154	0.05	Not Significant
Within Groups	301.65	583	0.52					
Total	303.59	585						

Data presented in Table 6 revealed that the P-value of 0.154 is greater than the 0.05 level of significance, indicating that there is no significant difference in the mean responses of lecturers, instructors, and students regarding the implementation challenges of AI in their institutions. Therefore, the null hypothesis of no significant difference was upheld.

Discussion of the Findings

The findings of this study presented in Table 1 reveal that respondents generally agreed that AI tools positively influence student engagement. Specifically, features such as AI-

powered chatbots, smart reminders, personalized content, and virtual tutors were rated highly. This aligns with Dixson (2015), who emphasized that online engagement is significantly increased when learners feel supported by interactive tools. AI technologies that personalize learning experiences, such as adaptive content and timely feedback, have been shown to improve cognitive engagement (Zawacki-Richter et al., 2019; Chen et al., 2020). Also, the finding that AI nudges and feedback mechanisms improve assignment completion and student confidence is consistent with the work of Luckin et al. (2016), who reported that intelligent tutoring systems (ITS) not only increase participation but also build learner autonomy. Similarly, Baker and Inventado (2014) observed that AI analytics help educators track student engagement in real time, thereby improving learning outcomes. The significant difference found in Table 4 between the responses of students, instructors, and lecturers on engagement suggests that while students might experience AI tools as engaging, instructors may require more training or exposure to appreciate their full potential (Holmes et al., 2022). This implies a gap in digital pedagogical literacy which must be addressed through capacity building.

Table 2 demonstrates that AI tools also enhance students' motivation. Respondents strongly agreed that features such as gamification, personalized learning paths, and AI-generated progress dashboards increased their interest and motivation to participate in online learning. These findings are supported by Hartnett (2016), who emphasized that motivation in online learning is strengthened when learners receive immediate feedback and autonomy in their learning pathways. Moreover, Keller's (2008) ARCS model of motivation confirms that relevance and confidence both of which are achievable through AI personalization and feedback are crucial for student motivation. AI systems that simulate workplace environments such as virtual labs also appear to increase extrinsic motivation, preparing learners for job markets a finding consistent with Nouri et al. (2020). The significant differences observed in Table 5 suggest disparities in how AI's motivational features are perceived across different respondent categories. While students may appreciate personalized learning, lecturers might still struggle with fully integrating these tools into course structures (Ifenthaler & Yau, 2020).

Table 3 indicates that although respondents recognized the potential of AI in practical and hands-on training, they were undecided or neutral on institutional preparedness. Low mean ratings on issues such as staff training, affordability, and infrastructural readiness (internet/power supply) highlight persistent implementation barriers. This is consistent with findings by Ebehikhalu & Patrick (2023) who reported that many Nigerian tertiary institutions lack sufficient infrastructure to support emerging technologies. The lack of significant

differences in perceptions across respondent categories in Table 6 confirms a shared concern about these limitations. Olutola (2021) and Akinola & Okonkwo (2023) have noted that poor funding and inadequate training impede the effective adoption of AI in Nigerian education. This is in line with UNESCO (2021) which emphasized that AI adoption in sub-Saharan Africa is hindered by inequality in digital access, lack of regulatory frameworks, and low human capital investment. Furthermore, Nguyen et al. (2024) argue that the full benefits of AI can only be realized when institutional support structures such as professional development programs, policy frameworks, and inclusive technology access are in place.

This study also confirms key principles of the Technology Acceptance Model (TAM), which posits that perceived usefulness and ease of use influence users' willingness to adopt technologies (Davis, 1989). The high ratings on AI feedback, virtual tutors, and progress tracking tools reflect high perceived usefulness among students, which could explain their positive attitudes toward AI-enhanced learning environments. However, neutral responses indicating neither agreement nor disagreement with statements on the adequacy of infrastructure and training suggest lower perceived ease of use among faculty and institutional administrators. The findings suggest that while AI is an effective tool for improving engagement and motivation in TVET online learning environments, its full potential is constrained by infrastructural, technical, and financial limitations. To ensure equitable and effective integration of AI in education, institutions must invest in digital infrastructure, train educators in AI pedagogy, and establish policies that guide ethical and inclusive AI use.

Conclusion

This study revealed that AI tools such as virtual tutors, personalized content delivery, automated feedback systems, and gamified learning platforms significantly improve students' learning experiences by increasing their engagement and motivation. However, the study also discovered several institutional limitations that hinder the full integration of AI in TVET education. These include inadequate infrastructure, limited access to AI tools, insufficient staff training, and financial constraints. The analysis further showed statistically significant differences in perceptions between students and educators on the benefits of AI, while there was a shared concern across all groups regarding implementation challenges. While AI presents transformative opportunities for enhancing teaching and learning in TVET, its successful adoption requires strategic investments in infrastructure, educator training, and inclusive policy frameworks. Addressing these gaps will not only improve the effectiveness of AI in education

but also ensure equitable access and sustainable digital transformation across Nigerian TVET institutions.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. Lecturers and instructors should actively incorporate AI tools such as adaptive learning and gamification into course design to make lessons more interactive and increase engagement.
2. The institutions should provide the necessary infrastructure and invest in reliable internet, power, learning analytics dashboards, AI chatbots, and virtual labs to support both students and teachers.
3. The government and school administrators should provide hands-on AI training programs for educators to ensure they can effectively use these new technologies.
4. TVET Policymakers should create clear national policies to ensure the ethical, equitable, and secure use of AI across all TVET institutions.

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