Journal of Computer & Robotics Education Research (JOCRE)
Vol. 2, No. 1, 2026

INTEGRATING ARTIFICIAL INTELLIGENCE INTO THE USE OF AI ADAPTIVE LEARNING IN VOCATIONAL TECHNICAL EDUCATION AND TRAINING TVET

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Abstract

This paper explores the application of AI in technical education. Descriptive survey study was adopted for the study. The population for the study was 150 technical education students and 10 instructors across three institutions that offer NCE (Technical) in Kano State. The instrument for data collection was structured questionnaire developed by the researcher based on literature. The instrument was validated by three experts. Twenty copies of the instrument were trial tested. Cronbach alpha reliability coefficient of 0.81 was realized. The researchers with help of three research assistants administered the instrument. Mean and standard deviation were used to answer the research questions. T-test was used to answer the hypotheses at 0.05 level of significance. The study found that AI tools improved students' performance enhanced engagement, and reduced instructor workload AI can provide insights into the strengths and weaknesses of each student, allowing educators to adapt their teaching methods accordingly. The study recommended teachers to adapt more self-directed in learning with personalized approaches; Colleges to accept personalized learning that improve job readiness; Teacher to create more diverse content types with AI; Government to support AI integration in teaching/learning and Virtual tutoring to form part of student interest in the TVET course.

Keywords: Artificial Intelligence (AI), Adaptive Learning, Integration of AI, TVET.

Introduction

Artificial intelligence (AI) is the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings, such as reasoning, learning, problem-solving, perception, and using language. According to Hoang et al., (2023) AI refers to computer systems that can perform complex tasks normally done by human reasoning, decision-making, creating, and more. The term is frequently applied to developing systems with the ability to reason, discover meaning, generalise, or learn from past

experiences (Li et al., 2024). AI and machine learning are not the same, but closely related. Machine learning is the method to train a computer to learn from inputs without explicit programming for every circumstance it helps a computer achieve AI (Powell, 2023). While no AI yet matches full human flexibility across wide domains, some AIs perform specific tasks as well as humans in teaching and learning.

Artificial intelligence (AI) in teaching and learning transforms education by personalising instruction, automating administrative tasks, creating interactive content, and enabling data-driven decisions making learning more dynamic, tailored, and effective for both students and educators. Analyses individual student data to tailor content to diverse learning styles, preferences, and capabilities. Zhou & Peng, (2025) stated that generate interactive materials like simulations, virtual labs, and educational games and Provides real-time support with immediate feedback and answers student questions, automates grading, attendance tracking and routine tasks so that teachers can focus on instruction and Identifies performance patterns to inform instructional strategies and curriculum development (Intelligence and Neuroscience, 2023) AI evaluates factual knowledge and critical thinking skills for comprehensive ability understanding. However, teachers use AI in the classroom to personalise learning by tailoring instructional content for diverse learners and integrating AI-generated simulations and virtual labs to make lessons interactive. Kshirsagar et al., (2022) also use virtual tutors for real-time student support, automate administrative tasks (grading, attendance) to save time and analyse student performance trends to identify areas for improvement (Webber et., al. 2025). According to Narayanan et al. (2023), the integration benefits of AI in education enhance creativity through innovative content creation, foster collaboration in learning environments, and support holistic education through comprehensive assessments. Addresses major educational challenges and accelerates progress toward learning goals by enabling independent learning and critical-thinking skills. AI offers transformative potential, and rapid technological development brings risks that must be guided by principles of inclusion, equity, and ethical use (Jiang, 2022). Hence, AI is a catalyst for a more dynamic and effective educational paradigm that goes beyond conventional teaching methods, preparing students for future multifaceted challenges in personalised learning

Personalised learning is an educational approach that tailor's instruction, learning experiences, and support to meet the distinct learning needs, interests, aspirations, and

cultural backgrounds of each individual student rather than using a "one-size-fits-all" model where all students receive the same lessons, assignments, and assessments. According to Ali et al., (2024), personalised learning makes individual learning needs the primary consideration in educational decisions, putting students at the center rather than what's convenient for teachers or the school. It's also called student-centered learning. Personalized learning maintains up-to-date records of each student's strengths, needs, motivations, progress, and goals updated far more often than report cards (Stoevelaar et al., 2022). Personalised learning paths create unique schedules/customised paths that adapt based on progress, motivations, and goals; may include project-based learning, independent work, and one-on-one tutoring. Personalised learning continuously assesses progress toward specific skills/knowledge; students move on when they master competencies rather than based on test pass/fail grades (Kathan et al., 2024). Personalised learning adapts physical classroom setup, daily structure, and teacher allocation based on how students learn best. Improve differentiated instruction in modifying assignments and teaching strategies for mixed-ability groups and personal learning plans for students. Create plans mapping academic, college, and career goals (Yuill & Kunz, 2022). Wilkinson et al. (2020) express the benefits of Personalized learning as improving student engagement and achievement or developing lifelong learners who take ownership of their learning, reducing the stigma of special education by focusing on strengths rather than just deficits and building self-advocacy skills, so that students become equal partners in learning and help struggling students get support sooner (Martinsen & Brennan, 2026). Therefore, in the TVET context, personalised learning could be particularly valuable for diverse vocational students with varying technical skills, career goals, and learning paces, allowing them to master competencies at their own speed while pursuing specific content creation in teaching and learning

Content creation in teaching and learning is the process of developing instructional materials such as worksheets, presentations, videos, assessments, interactive activities, and multimedia resources that educators use to deliver curriculum, engage students, and support learning objectives. Content creation allows teachers to customize materials to their students' specific needs rather than relying solely on standardized textbooks (Souza et al., 2020). Content creation matters in materials to students' needs, interests, curriculum, and learning objectives, making content more engaging. To create resources for concepts students, struggle with or complex processes needing explanation and the use variety of content types

(video, audio, visual) to engage different learning styles. AI tools automate routine tasks (generating practice questions, summarizing texts), freeing time for meaningful learning experiences (De la Casa Almeida et al., 2022). Effective content creation includes finding content, organizing, and write collected content. Present content, receive feedback from classmates and instructor and revise the content produced (Böhm & Lux, 2025). Traditionally, teachers spent countless hours manually designing worksheets, presentations, assessments lacking personalization. AI-powered platforms adapt to each student's needs, generate diverse resources, and enhance creativity (Lubicz-Nawrocka & Owen, 2022). AI adapts to learning styles through analyzes whether students learn better through visual aids, audio explanations or hands-on activities. Thus, AI tools don't replace teachers but enhance the ability to reach every student with relevant, engaging materials while freeing valuable time for building meaningful connections sometimes through virtual tutoring

Virtual tutoring refers as individualized learning support delivered through digital platform either via live online sessions with human tutors or through AI-powered intelligent tutoring systems that provides personalized instruction, immediate feedback, and adaptable learning experiences outside traditional classroom settings. The two Types of Virtual Tutoring are Human-Led Virtual Tutoring (Online Tutoring) and Live, face-to-face sessions with certified tutors conducted over video platforms (Tayce et al., 2022). Virtual tutoring is one–on–one or small group sessions via Zoom, virtual classrooms. Software that models student knowledge, provides step-by-step feedback, and adapts practice automatically (Schmied et al., 2024). Virtual Tutoring Works in three steps: 1. Assessment Student takes diagnostic to identify current level, 2. The Matching Platform assigns a suitable tutor based on needs and 3. Live sessions, face-to-face interaction via video platform (Mncube & Mthethwa, 2022). AI-powered Virtual tutoring process in four steps 1. Choose a topic. Tell AI what you want to learn, 2. Course creation AI generates a personalised course in seconds, 3. Learn at your own pace. Study whenever, wherever, through custom content and 4. Master subject complete course, pass quizzes, and achieve goals. Virtual tutoring is especially valuable for Technical and Vocational Education in Nigeria (Garzón-Artacho et al., 2021). Virtual tutoring doesn't replace teachers but enhances the ability to reach every student with relevant support while freeing time for meaningful connections and adaptive assessment.

Adaptive assessment (also called computer adaptive testing or CAT) is a type of personalized evaluation that dynamically adjusts question difficulty in real-time based on the

test-taker's responses to accurately measure individual ability levels. Adaptive Assessment Works as a test begins with a medium-difficulty question, Algorithm analyzes whether the answer is correct/incorrect. If correct: next question is harder; If incorrect: next question is easier (Machado & Kim, 2024). The assessment constantly reacts, so the test-taker never gets too many easy or too many hard questions. The "adaptive" part happens invisibly in the background; the test-taker may not notice it's adaptive. Methods in Medicine, (2023) stated that if a job candidate answers initial questions incorrectly, the assessment delivers easier questions. As they start answering correctly, it adjusts to deliver slightly harder questions. Kirenko et al.,(2024) stated the characteristics of adaptive assessment that Each test-taker sees a different set of questions based on their abilities, Questions adapt in real-time to performance, Generates short tests that are dynamically adapted to students' skills, learning styles, and behaviors, Identifies true ability level faster and more accurately than traditional assessments, Uses sophisticated algorithms to adjust to each person's ability level and Final score is a percentile (e.g., 45th percentile = scored higher than 45% of population) rather than raw score. Adaptive assessment provides highly accurate: Quickly identifies true ability level faster than other assessments, shorter tests: Generates brief, tailored tests that save time and precise measurement: Matches material to students' knowledge and abilities (Bouvy et al., 2016). These enhance students' engagement with material, matching their proficiency level and tailoring to students' specific needs, preferences, and proficiency levels and assess critical thinking skills for comprehensive understanding. They provide an accurate measurement of job-ready skills for employers, adjusts to conceptual, social, and practical learning styles and supports moving forward when competencies are mastered, not just test scores, the need for adaptive assessment. Therefore, Adaptive assessments offer tailored recommendations for implementation that can be adopted as guidelines to develop sophisticated assessment models for vocational education.

TVET stands for Technical and Vocational Education and Training, a comprehensive education and training system that provides the knowledge, practical skills, and competencies required for employment, entrepreneurship, and lifelong learning in various occupational fields. According to Retraction: A Dynamic Analysis of the Asymmetric Effects of the Vocational Education and Training on Economic Growth, Evidence from China (2023). TVET is "the education or training process which involves, in addition to general education, the study of technologies and related sciences and the acquisition of practical skills relating to

occupations in various sectors of economic life and social life. TVET encompasses is designed to equip young Nigerians with practical skills for employment and entrepreneurship and hands-on training at accredited centers across Nigeria's six geopolitical zones (Weidling et al., 2025). Skill Areas Being Trained: in Fashion, plumbing, agriculture, construction, digital media, automobile technology, renewable energy, electrical engineering, building construction, and more to address unemployment by providing employable skills (Looi et al., 2023). The TVET program is made to bridge the widening gap between education and industry needs, boost economic development through a skilled workforce, equip youth with skills to start businesses, and reduce dependency on white-collar jobs (Santos & Pereira, 2025). Modern TVET increasingly incorporates artificial intelligence for: Personalized learning, Virtual tutoring and Content creation. AI acts as a catalyst for a more dynamic educational paradigm that prepares TVET students for future multifaceted challenges. Providing alternatives to political thuggery through economic empowerment and rural development, bringing practical skills to communities across Nigeria (Swahn et al., 2018). TVET is not just about skills training; it's a strategic intervention for addressing Nigeria's youth unemployment, poverty, and security challenges through economic empowerment by integrating AI in TVET teaching and learning

Integrating AI in TVET teaching and learning refers to transforming technical and vocational education by making training more effective, personalized, industry-relevant, and accessible, bridging skills gaps between education and labor market demands for future workforce readiness. Ayanwale et al., (2025) stated that AI aligns educational outcomes with industry demands, addressing skills gaps, which provides personalized learning experiences for diverse learner needs and synchronizes curriculum with current labor market demands. AI adjusts content to students' technical skills, learning pace, and proficiency levels. It identifies whether students learn better through visual aids, audio, or hands-on activities, and AI-driven adaptive systems enhance student engagement and are critical for Nigerian TVET institutions to improve learning outcomes, adjust to students' technical proficiency in real-time and assesses both factual knowledge and problem-solving skills in vocational tasks. The competency-based progression that allows students to advance when competencies are mastered, not just test scores (Okoye et al., 2026). The evidence of Integrating AI in Nigerian TVET bridges skills gaps for the future workforce, enabling innovative content creation for technical skills using AI tools that facilitate communication among vocational students with

holistic education and critical thinking skills (Zhou & Peng, 2025). AI integration is particularly valuable for addressing research interests. AI aligns skills with industry demands; adaptive assessment evaluates job readiness (Duan et al., 2025). AI acts as a catalyst for a dynamic educational paradigm that prepares TVET students for multifaceted future challenges beyond conventional teaching methods (Alexander et al., 2025). Therefore, this guide provides tailored sophisticated AI-integrated TVET models in Nigeria and Kano state in particular.

Statement of the Problem

Ideally, lecturers of TVET need ongoing training in emerging online learning methods and technologies. Virtual tutoring such as AI integration offers opportunities for effective teaching and learning in TVET and other disciplines. Lecturers in TVET are expected to be well trained in personalize learning for effective teaching and learning students to acquire knowledge skills and attitude. Effective teaching and learning TVET is expected to produce well educated and trained graduates who will be self-employed and employed others. AI integration in TVET is expected to minimize technical difficulties, resource limitations, limited funding, limited interaction and practical skills delivery limitations.

However, many Nigerian TVET lecturers face challenges with AI integration in teaching and learning systems. Lecturers of TVET face significant challenges of infrastructure deficits, large class sizes of 20-40 students per class or more, which makes individualization seem impossible. TVET students progress academically at different speeds, some too quickly, some too slowly. TVET students have varying technical skills, ages, and educational histories. Lecturers face challenges of integrating AI content creation and visual tutoring that cater for these student's differences. Lecturers face practical skills delivery limitations which are characteristics of TVET. Lecturers face challenges of resource limitations, limited funding, and limited interaction couple with practical skills assessment which ways AI Adaptive assessment make easier.

It is against that, the study seek to determine; ways AI personalized learning is integrated into teaching and learning TVET, ways AI content creations are integrated is integrated into teaching and learning TVET, ways AI Visual tutoring is integrated into teaching and learning TVET, ways AI Adaptive assessment is integrated into teaching and learning Technical Vocational Education and Training in Colleges of Education in Kano State.

Purposes of the Study

The general purpose of the study is to determine ways Artificial Intelligence is integrated into the use of AI adaptive learning in Vocational Technical Education and Training TVET in Colleges of Education in Kano State. Specifically, the study seeks to determine:

1. ways AI personalized learning is integrated into teaching and learning Technical Vocational Education and Training in Colleges of Education in Kano State.
2. ways AI content creations are integrated into teaching and learning Technical Vocational Education and Training in Colleges of Education in Kano State.
3. ways AI Visual tutoring is integrated into teaching and learning Technical Vocational Education and Training in Colleges of Education in Kano State.
4. ways AI Adaptive assessment is integrated into teaching and learning Technical Vocational Education and Training in Colleges of Education in Kano State.

Research Questions

1. In what ways AI personalized learning are integrated into teaching and learning Technical Vocational Education and Training in Colleges of Education in Kano State?
2. In what ways AI content creations are integrated into teaching and learning Technical Vocational Education and Training in Colleges of Education in Kano State?
3. In what ways AI Visual tutoring are integrated into teaching and learning Technical Vocational Education and Training in Colleges of Education in Kano State?
4. In what ways AI Adaptive assessment are integrated into teaching and learning Technical Vocational Education and Training in Colleges of Education in Kano State?

Hypotheses

1. There are no significant differences in responses of teachers, instructors and students on ways AI personalized learning are integrated into teaching and

learning Technical Vocational Education and Training in Colleges of Education in Kano State.

2. There are no significant differences in responses of teachers, instructors and students on ways AI content creations are integrated into teaching and learning Technical Vocational Education and Training in Colleges of Education in Kano State.
3. There are no significant differences in responses of teachers, instructors and students on ways AI Visual tutoring are integrated into teaching and learning Technical Vocational Education and Training in Colleges of Education in Kano State.
4. There are no significant differences in responses of teachers, instructors and students on ways AI Adaptive assessment are integrated into teaching and learning Technical Vocational Education and Training in Colleges of Education in Kano State.

Methodology

Descriptive survey study was adopted for the study. The population for the study was 150 technical education students and 10 instructors across three institutions that offer NCE (Technical) in Kano State. The instrument for data collection was structured questionnaire developed by the researcher based on literature. The instrument was validated by three experts in the Department of Science and Technology Education Bayero University Kano. Twenty copies of the instrument were trial tested in the Department of Technical Education Isa Kaita College of Education Katsina State. Cronbach alpha reliability coefficient of 0.81 was realized. The researchers with help of three research assistants administered the instrument. Mean and standard deviation were used to answer the research questions. T-test was used to answer the hypotheses at 0.05 level of significance.

Result

Research Question 1: In what ways AI personalized learning is integrated into teaching and learning Technical Vocational Education and Training in Colleges of Education in Kano State?

Hypothesis 1: There are no significant differences in responses of teachers, instructors and students on ways AI personalized learning are integrated into teaching and learning Technical Vocational Education and Training in Colleges of Education in Kano State.

Table 1

S/N	Items	X	SD	ANOVA	Remark	Remark
1	Personalized learning has improved my motivation to learn	3.55	1.32	0.79	DA	S
2	I feel more engaged in my TVET classes with personalized instruction	3.63	1.26	0.27	DA	S
3	My academic performance has improved with personalized learning	3.51	1.31	0.30	DA	S
4	I have developed better critical thinking skills through personalized learning	3.53	1.31	0.37	DA	S
5	I feel more confident in my vocational skills	3.64	1.52	0.48	DA	S
6	Personalized learning has helped me achieve my career goals	3.58	1.30	0.05	DA	S
7	I am more self-directed in my learning with personalized approaches	3.60	1.50	0.10	A	S
8	Personalized learning has improved my problem-solving abilities	2.96	1.28	0.12	DA	S
9	I can apply what I learn more effectively to real-world situations	3.80	1.17	0.67	DA	S
10	Personalized learning has improved my job readiness	4.10	1.26	0.31	A	S
11	Personalized learning has improved my motivation to learn	3.58	1.10	0.00	DA	NS
12	I feel more engaged in my TVET classes with personalized instruction	3.64	1.43	0.01	DA	NS
13	My academic performance has improved with personalized learning	3.59	1.37	0.10	DA	S
14	I have developed better critical thinking skills through personalized learning	3.50	1.46	0.02	DA	NS
15	I feel more confident in my vocational skills	3.64	1.33	0.06	DA	S
16	Personalized learning has helped me achieve my career goals	3.61	1.48	0.44	DA	S
17	I am more self-directed in my learning with personalized approaches	3.55	1.20	0.12	A	S
18	Personalized learning has improved my problem-solving abilities	3.59	1.61	0.09	DA	S
19	I can apply what I learn more effectively to real-world situations	3.58	1.41	0.12	DA	S

20	Personalized learning has improved my job readiness	3.62	1.34	0.39	DA	S

Table 1 shows that items 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19 and 20 had their mean values above 3.50, meaning the respondents agreed with items as ways AI personalized learning is integrated into teaching and learning Technical Vocational Education and Training in Colleges of Education in Kano State. Items 8 had mean value below 3.50. This indicated that, the respondents disagree with items as ways AI personalized learning is integrated into teaching and learning Technical Vocational Education and Training in Colleges of Education in Kano State.

Research Question 2: In what ways AI content creations are integrated into teaching and learning Technical Vocational Education and Training in Colleges of Education in Kano State?

Hypothesis 2: There are no significant differences in responses of teachers, instructors and students on ways AI content creations are integrated into teaching and learning Technical Vocational Education and Training in Colleges of Education in Kano State.

Table 2

S/N	Items	X	SD	ANOVA	Remark	Remark
C1	**Technological Knowledge (AI Tools)**					
1	I understand how AI content creation tools work	3.57	1.37	0.93	DA	S
2	I can select the right AI tool for specific TVET content needs	3.72	1.45	0.96	DA	S
3	I troubleshoot basic AI tool technical issues independently	3.69	1.40	0.41	DA	S
C2	**Pedagogical Knowledge**					
4	AI-generated content aligns with my teaching/learning objectives	3.73	1.32	0.11	DA	S
5	AI content supports diverse learning styles in TVET	3.67	1.29	0.22	A	S
6	AI content enhances learner engagement and participation	3.66	1.35	0.86	DA	S
C3	**Content Knowledge (TVET Subject Matter)**					
7	AI-generated content is accurate for my TVET specialization	3.61	1.36	0.61	A	S
8	AI content includes relevant technical terminology	3.12	1.49	0.68	DA	S

9	AI content reflects current industry practices and standards	3.55	1.39	0.53	DA	S
C4	**Integrated AI-TPACK**					
10	I effectively combine AI tools with my teaching pedagogy	3.75	1.12	0.61	DA	S
11	AI content enhances practical skill demonstration in TVET	3.68	1.35	0.37	DA	S
12	I can evaluate and modify AI-generated content appropriately	3.56	1.36	0.65	DA	S
C5	**Content Quality and Validity**					
S/N	**Items**	**X**	**SD**	**ANOVA**	**Remark**	**Remark**
13	Accuracy of AI-generated technical information	3.75	1.36	0.73	DA	S
14	Clarity of explanations for complex TVET concepts	3.64	1.60	0.22	DA	S
15	Relevance to course curriculum and outcomes	3.50	1.55	0.21	DA	S
16	Quality of visual/diagrammatic content created by AI	3.75	1.43	0.44	DA	S
17	Suitability for hands-on/practical skill development	3.92	1.40	0.49	DA	S
18	Currency (up-to-date with industry standards)	3.63	1.15	0.12	DA	S
C6	**Learning Outcomes and Skill Development**					
19	AI-created content improved my understanding of TVET concepts	3.67	1.31	0.16	A	S
20	AI content helped me develop practical technical skills	3.56	1.39	0.15	DA	S
21	AI-generated assessments accurately measure my learning	3.62	1.26	0.03	DA	NS
22	AI content increased my confidence in applying skills	3.76	1.22	0.57	DA	S
23	I can transfer knowledge from AI content to real work situations	3.56	1.17	0.27	A	S
24	AI content supported my critical thinking development	3.82	1.18	0.56	DA	S
C7	**Efficiency and Time Savings**					
25	AI content creation reduced my preparation time (lecturers) / study time (students)	3.76	1.40	0.35	DA	S
26	AI tools made it easier to create customized learning materials	3.45	1.43	0.78	DA	S
27	AI content generation is faster than traditional methods	3.53	1.34	0.04	DA	NS

28	I can create more diverse content types with AI	3.60	1.32	0.27	A	S
C8	**Readiness for AI-Supported Instruction**					
29	My institution provides training on AI content creation	3.58	1.31	0.46	DA	S
30	I feel prepared to use AI tools for TVET content creation	3.67	1.33	0.10	DA	S
31	My institution has adequate AI infrastructure/tools	3.54	1.46	0.93	DA	S
32	I receive support for AI integration in teaching/learning	3.68	1.41	0.05	A	S

Table 2 shows items 1, 2, 3, 4, 6, 8, 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 20, 21, 22, 24, 25, 27, 29, 30 and 32 had mean values above 3.50. This indicated that, the respondents have agreed with the items as ways AI content creations are integrated into teaching and learning Technical Vocational Education and Training in Colleges of Education in Kano State. While items 8 and 26, had their values below 3.50. This indicated that, the respondents have not agreed with these two items as ways AI content creations are integrated into teaching and learning Technical Vocational Education and Training in Colleges of Education in Kano State. While the standard deviation ranges from 1.12 to 1.60, meaning there is close relationship among the mean responses on ways AI content creations are integrated into teaching and learning Technical Vocational Education and Training in Colleges of Education in Kano State.

Research Question Three: In what ways AI Visual tutoring is integrated into teaching and learning Technical Vocational Education and Training in Colleges of Education in Kano State?

Hypothesis 3: There are no significant differences in responses of teachers, instructors and students on ways AI Visual tutoring are integrated into teaching and learning Technical Vocational Education and Training in Colleges of Education in Kano State.

Table 3

S/N	Items	X	SD	ANOVA	Remark	Remark
Section A	**Virtual Tutoring Accessibility and Usability**					
1	Ease of accessing the virtual tutoring platform	3.62	1.25	0.52	DA	S

2	Quality of audio/video during tutoring sessions	3.52	1.22	0.69	DA	S
3	User interface clarity (navigation, menus, tools)	3.68	1.26	0.54	DA	S
4	Reliability of the platform (no crashes/disconnections)	3.53	1.27	0.46	DA	S
5	Availability of tutoring sessions (schedule flexibility)	3.72	1.36	0.63	DA	S
Section B	**Tutoring Quality and Pedagogical Effectiveness**					
6	Tutor's knowledge of the TVET subject matter	3.80	1.23	0.55	A	S
7	Tutor's ability to explain technical concepts clearly	3.52	1.16	0.20	DA	S
8	Use of relevant examples and practical demonstrations	3.75	1.12	0.66	DA	S
S/N	**Items**	**X**	**SD**	**ANOVA**	**Remark**	**Remark**
9	Encouragement of learner participation and questions	3.62	1.20	0.45	DA	S
10	Provision of timely feedback on assignments/tasks	3.79	0.96	0.45	DA	S
11	Alignment of tutoring content with course objectives	3.45	1.11	0.55	DA	S
Section C	**Learning Outcomes and Skill Development**					
12	Virtual tutoring improved my understanding of TVET concepts	3.75	1.42	0.35	DA	S
13	I feel more confident in applying technical skills after tutoring	3.76	1.38	0.69	DA	S
14	My problem-solving skills in my field have improved	3.61	1.30	0.50	DA	S
15	Virtual tutoring helped me prepare for practical assessments	3.57	1.37	0.32	DA	S
16	I can transfer what I learned in tutoring to real work situations	3.59	1.16	0.21	A	S
Section D	**Engagement, Motivation, and Self-Efficacy**					
17	Virtual tutoring increased my interest in the TVET course	3.59	1.28	0.69	A	S
18	I am more motivated to learn after using virtual tutoring	3.60	1.08	0.25	A	S
19	I feel more confident learning independently (self-efficacy)	3.70	1.13	0.18	DA	S
20	I actively participate in virtual tutoring sessions	3.55	1.27	0.04	DA	S
21	The tutoring environment supports my learning agility	3.79	1.19	0.36	DA	S

Table 3 shows that the items1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 20, and 21 had their mean values above 3.50 This indicated that, the respondent have agreed with the items as ways AI Visual tutoring is integrated into teaching and learning Technical Vocational Education and Training in Colleges of Education in Kano State. Item 11 had mean value below 3.50, meaning the respondents disagree with the item as way AI Visual tutoring is integrated into teaching and learning Technical Vocational Education and Training in Colleges of Education in Kano State. While the standard deviation ranges from 0.04 to 1.42, meaning there is close relationship in the mean responses of the respondents.

Research Question 4: In what ways AI Adaptive assessment is integrated into teaching and learning Technical Vocational Education and Training in Colleges of Education in Kano State?

Hypothesis 4: There are no significant differences in responses of teachers, instructors and students on ways AI Adaptive assessment are integrated into teaching and learning Technical Vocational Education and Training in Colleges of Education in Kano State.

S/N	Items	X	SD	ANOVA	Remark	Remark
1	I have received training on adaptive assessment methods	3.55	1.07	0.09	DA	S
2	Instructors have received training on adaptive assessment implementation	3.61	1.05	0.08	DA	S
3	Institution offers professional development on computerized adaptive testing	3.75	1.29	0.06	DA	S
4	I understand how adaptive assessment algorithms work	3.60	1.41	0.77	DA	S
5	I receive feedback on how to interpret adaptive assessment results	3.42	1.37	0.19	DA	S
6	Institution provides resources for adaptive assessment development	3.51	1.36	0.13	DA	S
7	I participate in communities of practice for adaptive assessment	3.70	1.17	0.11	DA	S
8	I have time allocated for learning adaptive assessment tools	3.71	1.23	0.10	A	S
9	Adaptive assessments have improved my understanding of technical concepts	3.66	1.33	0.12	DA	S
10	Immediate feedback from adaptive assessments helps me learn better	3.50	1.36	0.65	DA	S
11	Adaptive assessments have improved my academic performance/grades	3.68	1.24	0.40	DA	S
12	Adaptive assessments help me identify areas needing improvement	3.59	1.38	0.67	DA	S

13	Adaptive assessments have increased my motivation to learn	3.70	1.26	0.36	A	S
14	Adaptive assessments have improved my problem-solving abilities	3.59	1.34	0.40	DA	S
15	Adaptive assessments have enhanced my confidence in technical subjects	3.54	1.39	0.03	DA	S
16	Adaptive assessments have prepared me better for employment	3.52	1.38	0.04	A	NS
17	Adaptive assessments help me achieve competency-based progression	3.24	1.27	0.02	DA	NS
18	Adaptive assessments have improved my critical thinking abilities	3.65	1.07	0.07	DA	S

Table 4 shows that, items 1, 2, 3, 4, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16, and 18 had their mean values above 3.50, meaning the respondents have agreed with the items as ways AI Adaptive assessment is integrated into teaching and learning Technical Vocational Education and Training in Colleges of Education in Kano State. Items 5 and 17 had their values below 3.50, meaning respondents disagree with the items as ways AI Adaptive assessment is integrated into teaching and learning Technical Vocational Education and Training in Colleges of Education in Kano State. While the standard deviation ranges from 1.05 to 1.39, meaning there is close relationship among the mean responses on ways AI Adaptive assessment are integrated into teaching and learning Technical Vocational Education and Training in Colleges of Education in Kano State.

Findings

1. AI personalized learning improves personalized learning in TVET.
2. AI personalized learning provides self-directed learning in TVET.
3. AI personalized learning provides personalized approaches in TVET.
4. AI personalized learning improves job readiness in TVET.
5. AI personalized learning provides self-directed learning approaches in TVET.
6. Integration of AI content creations support diverse learning styles in TVET.
7. AI Visual tutoring provides relevant examples and practical demonstrations in TVET.
8. AI Visual tutoring improves problem-solving skills in TVET.
9. AI Adaptive assessment increases motivation to learn TVET.

Discussion of Findings

The study found out that, AI tools improved students' performance enhanced engagement, and reduced instructor workload. This finding is in line with Al Nabhani et al.,

(2025) who found out that, AI could play a crucial role in enhancing personalized learning content and improving academic performance and engagement between students and teachers. The study also found out that, AI can provide insights into the strengths and weaknesses of each student, allowing educators to adapt their teaching methods accordingly. This finding supported Tira (2021) who stated that AI can provide feedback on student learning activities and practice questions, provide recommendations for material that needs to be re-studied like a teacher or tutor. AI can help bridge the gap between theory and practice in the classroom. This finding is in line with Alakayle (2025) ho found out that,AI systems could help Jordanian schools bridge the gap between theory and practice, making mastery learning and differentiated instruction viable even in large, resource-constrained classrooms.

Conclusions

The integration of Artificial Intelligence (AI) into Technical and Vocational Education (TVE) has the potential to greatly enhance the learning experience for students. Through the use of AI, TVE can be personalized to meet the needs of individual learners, providing them with a more engaging and effective learning environment. One way in which AI can enhance TVE is through the use of adaptive learning technologies. These technologies use AI algorithms to analyze student data and adjust the learning materials and activities accordingly. This allows for a more personalized learning experience, where students can progress at their own pace and focus on areas where they need more support. Another benefit of integrating AI into TVE is the ability to provide students with real-world scenarios and simulations. By using AI, these simulations can be intelligent and responsive, providing students with a more realistic and engaging learning experience. This can also help students develop important problem-solving skills that are essential for success in the workforce. In addition, AI can assist TVE educators in developing more effective and targeted teaching strategies. By analyzing student data, AI can provide insights into the strengths and weaknesses of each student, allowing educators to adapt their teaching methods accordingly. This can lead to more efficient use of classroom time and better learning outcomes for students. Overall, integrating AI into TVE has the potential to revolutionize the way we approach education. By enhancing the learning experience for students and providing educators with valuable insights, AI can help bridge the gap between theory and practice in the classroom. This will ultimately lead to a more skilled and knowledgeable workforce, better equipped to meet the demands of the modern world

Recommendations

1. Teachers to adapt more self-directed in learning with personalized approaches
2. Colleges to accept personalized learning that improve job readiness
3. Teacher to create more diverse content types with AI
4. Government to support AI integration in teaching/learning
5. Virtual tutoring to form part of students interest in the TVET course

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